Stage 2 Disinfectants and Disinfection Byproducts Rule Initial Distribution System Evaluation Guidance Manual

Draft for Discussion – Do not Circulate

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Glossary

BAT	Best available technology
CWS	Community water system
CT	Residual disinfectant concentration (in mg/L) multiplied by the contact time (in min)—a measure of inactivation
DBP	Disinfection byproduct
DBPR	Disinfectants and Disinfection Byproducts Rule
EBCT	Empty bed contact time
ES	Enhanced softening
EPS	Extended period simulation
GAC	Granular activated carbon
HAA	Haloacetic acid
HAA5	The sum of five HAA species
HPC	Heterotrophic plate count
ICR	Information Collection Rule
IDSE	Initial distribution system evaluation
LRAA	Locational running annual average
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
MCAA	Monochloroacetic acid
MCL	Maximum contaminant level
MCLG	Maximum contaminant level goal
M-DBP	Microbial and disinfection byproduct
MF	Microfiltration
NF	Nanofiltration
NPDWR	National Primary Drinking Water Regulation
NTNCWS	Nontransient noncommunity water system
PWS	Public water system
RAA	Running annual average
RO	Reverse osmosis
SCADA	Supervisory control and data acquisition
SDS	Simulated distribution system
SDWA	Safe Drinking Water Act
SMP	Standard monitoring program
SOC	Synthetic organic compound
SSS	System-specific study
TCAA	Trichloroacetic acid
THM	Trihalomethane
TOC	Total organic carbon

TNCWS	Transient noncommunity water system
TTHM	Total trihalomethanes
UF	Ultrafiltration
UV	Ultraviolet light
WDS	Water distribution system

Definitions

Aquifer: a geological formation composed of rock, gravel, sand, or other porous material that yields water to wells or springs.

Best professional judgement: using knowledge and experience to make a decision on an issue that does not have a clear direction or answer, or deciding to take an alternative path to the one recommended based on knowledge and experience.

Booster disinfection: the practice of raising disinfectant concentration in areas of the distribution system where the residual disinfectant has been depleted.

Chlorine residual: the concentration of chlorine that is maintained in the distribution system to prevent microbial growth.

Combined distribution system: the totality of the distribution systems of all interconnected wholesale systems and consecutive systems.

Community water system: a public water system that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

Conductivity: a measurement of the ability of a solution to carry an electrical current.

Consecutive entry point: a location at which finished water is delivered from a wholesale system to a consecutive system that buys some or all of its water, at least 60 days per year.

Consecutive system: a public water system that buys or otherwise receives some or all of its finished water from one or more other public water systems.

Controlling month: the month of historical peak DBP levels, or, in the absence of DBP data, the month of highest water temperature.

Disinfectant: any oxidant, including but not limited to chlorine, chlorine dioxide, chloramines, and ozone, added to water in any part of the treatment or distribution process, that is intended to kill or inactivate pathogenic microorganisms.

Disinfectant residual: the concentration of disinfectant that is maintained in the distribution system to prevent microbial growth.

Disinfection: a process that inactivates pathogenic organisms in water by chemical oxidants or other agents.

Disinfection byproduct: compound formed from the reaction of a disinfectant with organic and inorganic compounds in the source water during the disinfection process.

Dual Samples: Samples that are collected analyzed for both TTHM and HAA5.

Entry point: the point of the distribution system where potable water enters the system.

Free chlorine residual: the amount of free chlorine remaining after a given contact time.

Ground water under the direct influence of surface water (GWUDI): any water beneath the surface of the ground with (1) significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as *Giardia lamblia* or *Cryptosporidium* (for subpart H systems serving at least 10,000 people only), or (2) significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions. Direct influence must be determined for individual sources in accordance with criteria established by the State.

Haloacetic acid: one of the family of organic compounds named as a derivative of acetic acid, wherein one to three hydrogen atoms in acetic acid are each substituted by a halogen atom in the molecular structure.

Haloacetic acids (five) (HAA5): the sum of the concentrations of the haloacetic acid compounds (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid).

Heterotrophic plate count (HPC): a procedure for estimating the number of heterotrophic bacteria in water, measured as the number of bacteria per milliliter.

Influence zone: the influence zone for a plant represents all parts of the distribution system where that plant provides water at some time during the year.

Locational running annual average (LRAA): the average of quarterly averages for all samples taken at a particular monitoring location during the previous four calendar quarters.

Maximum contaminant level (MCL): the maximum permissable level of a contaminant in water that is delivered to any user of a public water system. MCLs are enforceable standards.

Maximum contaminant level goal (MCLG): the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of a person would occur, and which allows an adequate margin of safety. Maximum contaminant level goals are non-enforceable health goals.

Mixing Zone: an area in the distribution system where water flowing from opposite directions meets.

Monitoring location: the location where samples are collected.

Nontransient noncommunity water system: a public water system that regularly serves at least 25 of the same persons over 6 months of the year.

Noncommunity water system: a public water system that is not a community water system.

Public water system (PWS): a system for the provision of water for human consumption through pipes or, after August 5, 1998, other constructed conveyances, if such system has at least fifteen service connections or regularly serves an average of at least twenty-five individuals daily at least 60 days out of the year. Such term includes: any collection, treatment, storage, and distribution facilities under control of the operator of such systems and used primarily in connection with such system; and any collection or pretreatment storage facility not under such control which are used primarily in connection with such system. Such term does not include any “special irrigation district.” A public water system is either a “community water system” or a “noncommunity water system.”

Residence time: the time period lasting from when the water is treated to when it is delivered to the consumer.

Residual disinfectant: the disinfectant added to provide or maintain a residual in the distribution system. Also referred to as “secondary disinfectant.”

Running annual average: the average of monthly or quarterly averages of all samples taken throughout the distribution system.

Service connection: as used in the definition of public water system, does not include a connection to a system that delivers water by a constructed conveyance other than a pipe if:
(1) The water is used exclusively for purposes other than residential uses (consisting of drinking, bathing, and cooking, or other similar uses);

(2) The State determines that alternative water to achieve the equivalent level of public health protection provided by the applicable national primary drinking water regulation is provided for residential or similar uses for drinking and cooking; or
(3) The State determines that the water provided for residential or similar uses for drinking, cooking, and bathing is centrally treated or treated at the point of entry by the provider, a pass-through entity, or the user to achieve the equivalent level of protection provided by the applicable national primary drinking water regulations.

State: the agency of the State, U.S. Territory, or Tribal government that has jurisdiction over public water systems. During any period when a State, U.S. Territory, or Tribal government does not have primary enforcement responsibility pursuant to section 1413 of the Safe Drinking Water Act, the term "State" agency means the Regional Administrator, U.S. Environmental Protection Agency.

Subpart H systems: public water systems using surface water of ground water under the direct influence of surface water as a source that are subject to the requirements of subpart H of this part (40 CFR 141), commonly known as the SWTR.

Surface water: all water that is open to the atmosphere and subject to surface runoff.

Total trihalomethanes (TTHM): the sum of concentrations of the four trihalomethane compounds (chloroform, dibromochloromethane, bromodichloromethane, and bromoform).

Total chlorine residual: the sum of combined chlorine (chloramine) and free available chlorine residual.

Tracer study: a procedure for estimating hydraulic properties of the distribution system, such as residence time. Where more than one water source feeds the distribution system, tracer studies can be used to determine the zone of influence of each source.

Trihalomethane (THM): one of the family of organic compounds named as derivatives of methane, wherein three of the four hydrogen atoms in methane are each substituted by a halogen atom in the molecular structure.

Unpaired sample: a sample analyzed for either TTHM or HAA5.

Water distribution system model: a computer program that can simulate the hydraulic behavior of water in a distribution system.

Wholesale system: a public water system that sells or otherwise delivers finished water to another public water system at least 60 days per year.

1.0 Introduction

This manual provides guidance to water systems and regulatory agencies for performing and determining the adequacy of Initial Distribution System Evaluations (IDSEs) as required by the Stage 2 Disinfectants and Disinfection Byproducts Rule (DBPR). IDSEs are studies conducted by water systems to select new compliance monitoring locations that more accurately represent peak disinfection byproduct (DBP) concentrations in the distribution system. This manual describes IDSE requirements and options for meeting those requirements, and provides guidance for selecting final compliance monitoring locations that meet Stage 2 DBPR requirements.

The remainder of this introductory chapter is organized as follows—

1.1 Summary of Stage 2 DBPR Provisions
1.2 Requirements for Conducting the IDSE
1.3 Criteria for Obtaining a Waiver or Exemption from the IDSE
1.4 Guidance Manual Organization

1.1 Summary of Stage 2 DBPR Provisions

The Stage 2 DBPR builds on the 1979 Total Trihalomethane Rule and the 1998 Stage 1 DBPR by requiring better control of DBPs in water distribution systems. The Stage 2 DBPR is designed to reduce peak DBP concentrations, in part, by changing Stage 1 DBPR compliance monitoring locations. To determine new monitoring locations, most systems will perform an IDSE. The purpose of the IDSE is to revise monitoring locations to more accurately represent high concentrations of total trihalomethane (TTHM) and the sum of five haloacetic acids (HAA5).

The Stage 2 DBPR also changes the way sampling results are averaged to determine compliance. The maximum contaminant levels (MCLs) for TTHM and HAA5 remain the same as those in the Stage 1 DBPR (0.080 mg/L (80 Fg/L) for TTHM and 0.060 mg/L (60 Fg/L) for HAA5).[1] However, the compliance determination is based on a locational running annual average (LRAA), as opposed to the system-wide running annual average (RAA) used under the Stage 1 DBPR. For LRAAs, the MCLs must be met at every monitoring location while the RAA allows the system to average results over all monitoring locations.

The Stage 2 DBPR applies to all community water systems (CWSs) and nontransient noncommunity water systems (NTNCWSs) that add a primary or residual disinfectant other than

[1] Although the MCLs are stated in mg/L in the Stage 2 DBPR, for consistency with the terminology in this guidance manual, they are converted to Fg/L.

Ultraviolet light (UV) or deliver water that has been disinfected by a primary or residual disinfectant other than UV. The rule will be implemented in two stages.

Stage 2A: [3 years after rule promulgation][2], all systems must comply with TTHM/HAA5 MCLs of 120/100 Fg/L measured as LRAAs at each Stage 1 DBPR monitoring site and continue to comply with the Stage 1 DBPR MCLs of 80/60 Fg/L measured as RAAs.

Stage 2B: [6 years after rule promulgation], systems serving 10,000 people or more must comply with the 80/60 MCLs measured as LRAAs at the monitoring sites identified during the IDSE. For small systems required to do *Cryptosporidium* monitoring under the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), compliance with the 80/60 MCLs measured as LRAAs will begin [8.5 years after rule promulgation]. For all other small systems, compliance with the 80/60 Fg/L MCLs measured as LRAAs will begin [7.5 years after rule promulgation].

Under Section 1412 (b)(10) of the Safe Drinking Water Act (SDWA), systems are eligible for a two year extension if capital improvements are required to comply with the MCLs.

1.2 Requirements for Conducting the IDSE

IDSE requirements apply to all Subpart H[3] and ground water CWSs that use a primary disinfectant other than UV or add a residual disinfectant to their water, or CWSs that deliver such water. The same requirements apply to NTNCWSs *except* those that serve fewer than 10,000 people – these systems are not required to conduct an IDSE; however they may still need to select revised Stage 2B monitoring locations and submit a report. See Chapter 7 for requirements for NTNCWSs serving less than 10,000 people.

Some systems may be exempt from or receive waivers to the IDSE. Section 1.3 details the requirements for obtaining an exemption or waiver to the IDSE.

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[2] Exact deadlines will be provided at a later date.

[3] Subpart H systems are public water systems using surface water or ground water under the direct influence of surface water that are subject to the requirements of the Surface Water Treatment Rule.

There are two options for conducting an IDSE—

1) Perform one year of distribution system monitoring under a schedule and plan determined by system size, source water type, and number of plants. This option is referred to as the IDSE **Standard Monitoring Program (SMP)** within this document. SMP requirements are presented in detail in Chapters 2 through 4. See Table 1.1 for a summary of SMP requirements by system source type and size.

Table 1.1 Summary of SMP Sample Site Requirements

System Characteristics (Population Served)	Residual Disinfectant	SMP Sample Sites per Plant				
		Entry Point	Average Residence Time	High TTHM	High HAA5	Total Sites
Subpart H systems (≥ 10,000)	Chlorine	1	2	3	2	**8**
	Chloramines	2	2	2	2	**8**
Subpart H systems (500 - 9,999)	Chlorine or Chloramines	-	-	1	1	**2**
Subpart H systems (< 500)	Chlorine or Chloramines	-	-	1	1	**2**
Ground water systems (≥ 10,000)	Chlorine or Chloramines	-	-	1	1	**2**
Ground water systems (< 10,000)	Chlorine or Chloramines	-	-	1	1	**2**

2) Perform a **System-Specific Study (SSS)**. There are a number of possible SSS options, including the use of historical DBP data and water distribution system modeling. Data collected under an SSS must provide equivalent or better information on site selection for the Stage 2 DBPR monitoring. Two pre-defined options are described in detail in Chapter 6.

All systems conducting an IDSE must submit an IDSE report to their State[4] summarizing the results of the SMP or SSS. Example reports are presented in Appendices C-H. If you perform an IDSE SMP, your report must contain the following—

- Original SMP monitoring plan and an explanation of any deviations from that plan
- All SMP TTHM and HAA5 analytical results
- All TTHM and HAA5 analytical results from Stage 1 DBPR compliance monitoring collected during the period of the IDSE
- A schematic of your distribution system with results, location, and date of all IDSE SMP and compliance samples noted
- Recommendations for locating Stage 2B compliance monitoring sites
- Justification for selection of Stage 2B compliance monitoring sites

It is also highly recommended that you include justification for selecting SMP monitoring sites in your IDSE SMP report. Your IDSE SSS report must include all studies, reports, data, analytical results, and modeling to support the selection of your Stage 2B compliance monitoring sites.

Your IDSE report is due to your State at the same time as the largest system in the combined distribution system (a *combined distribution system* is the totality of the distribution systems of all interconnected wholesale and consecutive systems). This compliance schedule requirement applies to IDSE performance and report submission.

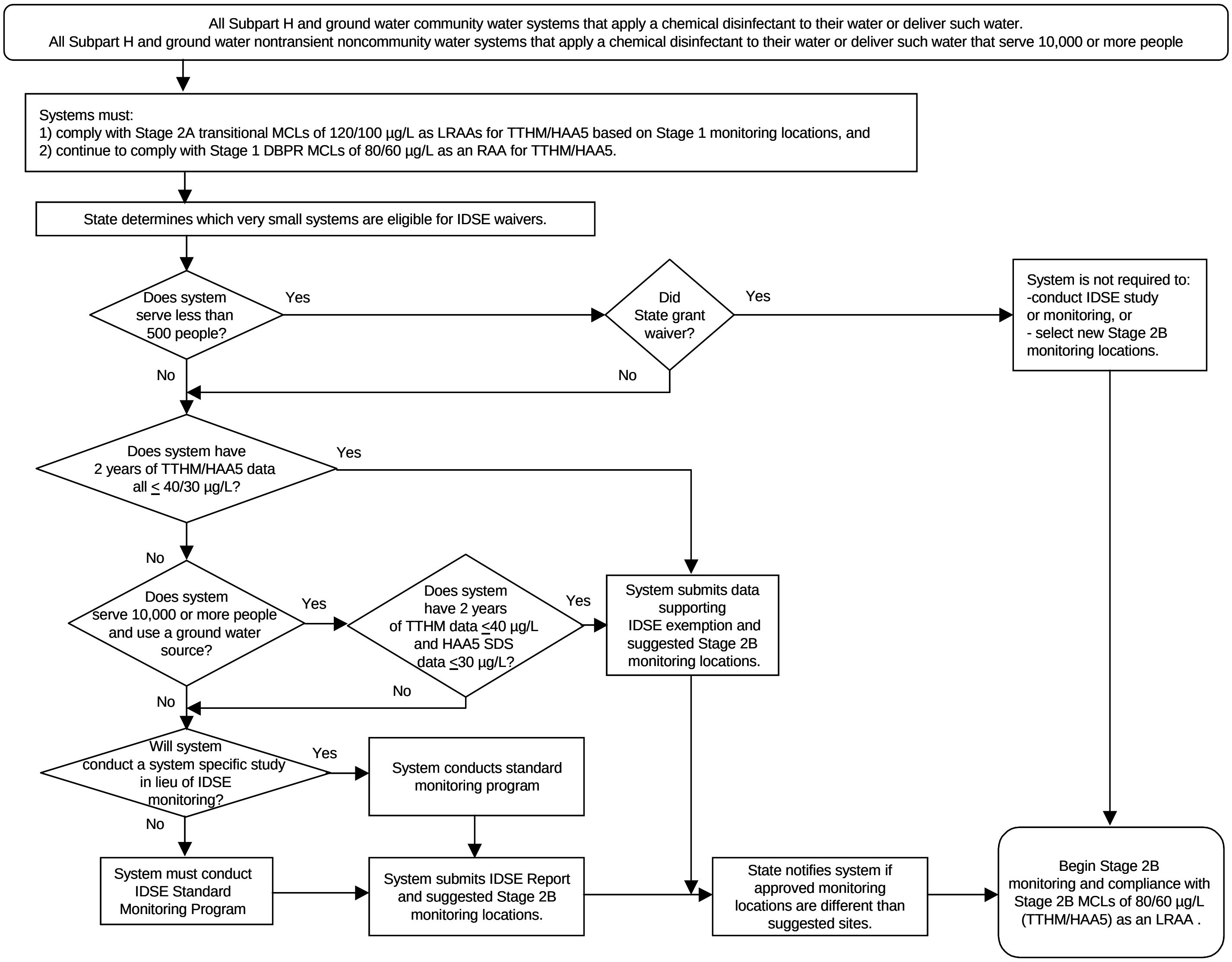
- If the largest system in the combined distribution system serves <u>10,000 or more people</u> your IDSE report is due [2 years after final rule promulgation].

- If the largest system in the combined distribution system serves <u>less than 10,000 people</u> your IDSE report is due [4 years after final rule promulgation].

Figure 1.1 shows how the IDSE fits into the overall implementation of the Stage 2 DBPR.

[4] The term “State” includes other primacy agencies, such as U.S. territories and tribal governments which have jurisdiction over public water systems. Where a State, U.S. territory, or tribal government does not have primacy, the term “State” refers to the EPA Regional Administrator.

Figure 1.1 Summary of IDSE Requirements



1.3 Criteria for Obtaining a Waiver or Exemption from the IDSE

Table 1.2 summarizes the criteria for obtaining an exemption or waiver to the IDSE. Detailed requirements are provided in Sections 1.3.1 and 1.3.2.

Table 1.2 IDSE Exemption Criteria

System Characteristics	Exemption Criteria
All systems	All individual TTHM/HAA5 Stage 1 DBPR compliance data are ≤ 40/30 Fg/L during the specified period
CWSs serving less than 500 people	Eligible for a waiver if Stage 1 DBPR site represents the highest concentration of both TTHM and HAA5 (based on State determination)

1.3.1 Systems with Historical TTHM/HAA5 Data below 40/30 Fg/L

Systems demonstrating low historic TTHM and HAA5 distribution system concentrations **may** be exempt from performing the IDSE. To be exempt, your data must meet the following criteria—

9) All individual TTHM results must be less than or equal to 40 Fg/L

10) All individual HAA5 results must be less than or equal to 30 Fg/L

11) Results must span at least a [two-year period prior to Stage 2 DBPR site selection for subpart H systems] and must include all Stage 1 compliance monitoring results

12) TTHM and HAA5 samples must have been analyzed by a laboratory certified under the drinking water certification program to perform these measurements and using approved methods

13) For ground water systems serving 10,000 or more people with historical TTHM data but no HAA5 data, a simulated distribution system (SDS) test can be used to evaluate HAA5 concentrations. Historical TTHM data must be below 40 Fg/L and SDS HAA5 data below 30 Fg/L for systems to qualify. See Appendix B for more information on SDS tests.

Even though you may not conduct an IDSE, you must evaluate your existing Stage 1 DBPR sites to determine if they meet the requirements of the Stage 2 DBPR. Chapter 7 provides additional guidelines on selecting Stage 2B DBPR sites for systems that are exempt from the IDSE.

Once you have identified your Stage 2B DBPR monitoring sites using your historical data, you must submit a IDSE Report to the State with all TTHM and HAA5 analytical results from compliance monitoring conducted prior to the period of the IDSE (see Chapter 7 for more details on report requirements).

1.3.2 CWSs Serving Fewer Than 500 People

CWSs serving fewer than 500 people are eligible for an IDSE waiver if the State determines that the Stage 1 DBPR monitoring site (the location of maximum residence time in the distribution system) represents the highest concentration for both TTHM and HAA5 concentrations. This will often be the case because small systems tend to be less complicated hydraulically than larger systems. Possible scenarios that indicate that the highest TTHM and HAA5 concentrations may **not** occur at the same location include the following—

- Inability to maintain a disinfectant residual in all parts of the system. Areas with very low or no disinfectant residual can have long residence times and may have some biological activity. These areas might have high TTHM due to long residence time, while their HAA5 concentrations in the same location may be lower than other locations. Therefore, another location with low but positive disinfectant residual could have higher HAA5 concentrations.

- High heterotrophic plate count (HPC) results, if HPC data are available. High HPC counts can indicate biological activity or biofilm growth in a part of the system. In some cases, positive coliform results may also indicate biofilm growth (some coliform species have been identified in distribution system biofilms; however positive coliform results are typically associated with system contamination, so these data should be viewed with caution). Areas of biological activity and/or biofilm growth may have lower HAA5 concentrations.

- TTHM concentration is greater than 4 times the HAA5 concentration at the Stage 1 DBPR monitoring site (possibly indicating degradation of HAA5 in the system). Data collected under the 1996 Information Collection Rule showed that the difference in TTHM and HAA5 was greater if the maximum TTHM and HAA5 concentrations occurred at different locations in the distribution system for a given sample period.

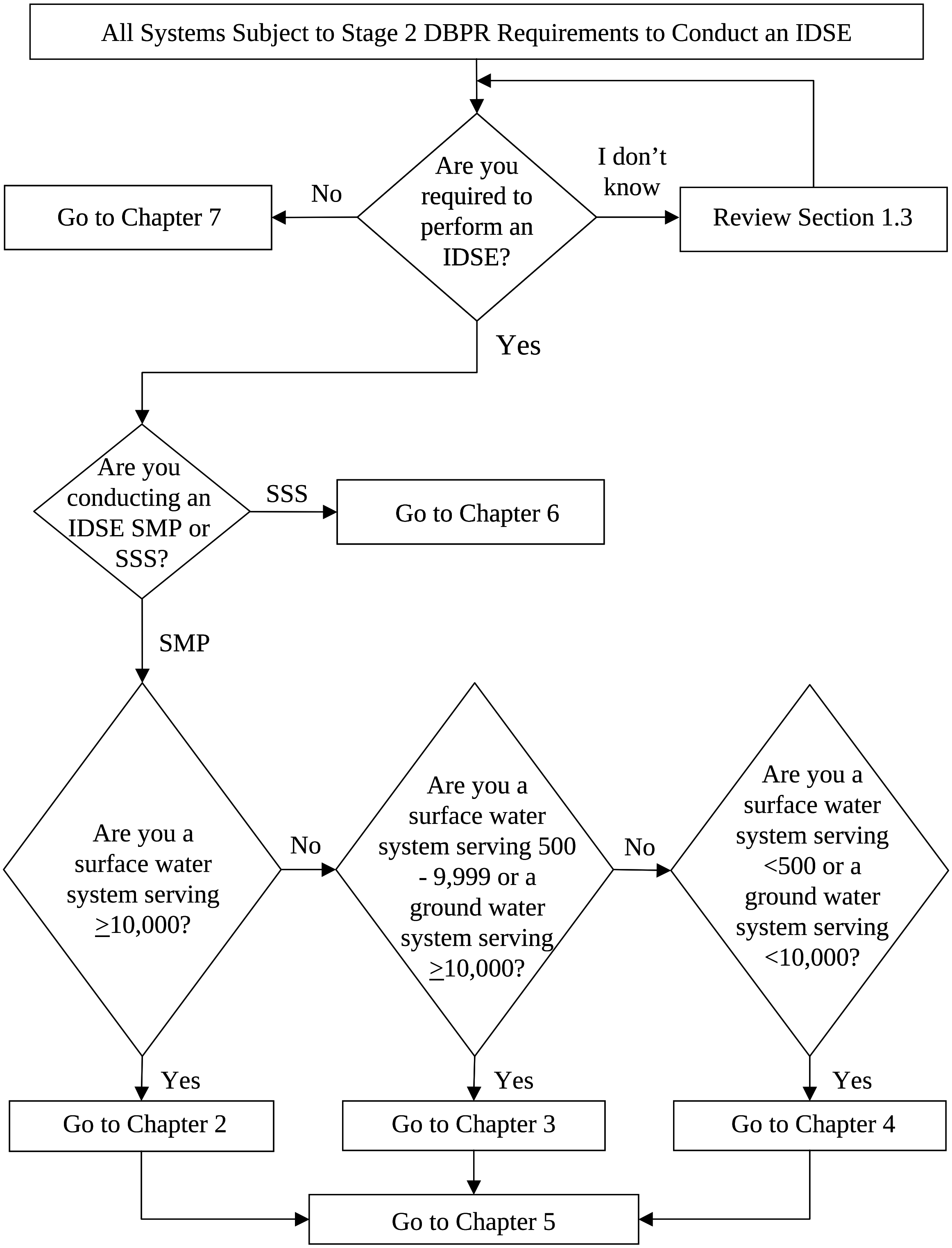
These guidelines are not all-inclusive—TTHM and HAA5 formation depends on many system-specific factors. You should evaluate your distribution system and data to determine if your highest TTHM and HAA5 concentrations occur at the same location. Additional detail and guidance on evaluating the Stage 1 DBPR site are provided in Chapter 7.

If you or the State decide that the highest TTHM and HAA5 concentrations **do not** occur at the same location, you must perform an IDSE (see Chapter 4 for IDSE SMP requirements for systems serving less than 500 people).

1.4 Guidance Manual Organization

The decision tree in Figure 1.2 can be used to guide you through the remainder of this guidance manual.

Figure 1.2 IDSE Guidance Manual Organization



2.0 Standard Monitoring Program Requirements for Subpart H Systems Serving 10,000 or More People

2.1 Introduction

This chapter describes the IDSE Standard Monitoring Program (SMP) requirements for subpart H systems[1] serving 10,000 or more people. These requirements include monitoring schedule, frequency, and locations in the distribution system. Chapter 5 builds on this chapter by describing how final SMP monitoring sites should be selected using various sources and tools. The remainder of this section is organized as follows—

2.2 Schedule for Conducting the IDSE SMP
2.3 Number of Samples Required
2.4 Sample Location Requirements
2.5 Timing of SMP Sample Collection
2.6 Sampling Protocol

Although some guidance in this chapter is appropriate for other system types and sizes, this chapter specifically addresses **subpart H systems serving 10,000 or more people**. Refer to Chapters 3 and 4 for guidance directed towards other source water types and system sizes.

2.2 Schedule for Conducting the IDSE SMP

The IDSE report is due to your State [2 years after rule promulgation][2]. SMP sampling will take approximately 12 months. Analyses of the final round of samples, review of the results, the choice of new compliance sites, and completion of your report are estimated to take approximately 3 months. Therefore, it is recommended that you begin IDSE SMP sampling [no later than 15 months before the IDSE report is due to your State].

> IDSE SMP sampling should begin [no later than *15 months* before your IDSE report is due].

[1]Subpart H systems use surface water or ground water under the direct influence of surface water as a source and are subject to the requirements of the Surface Water Treatment Rule.

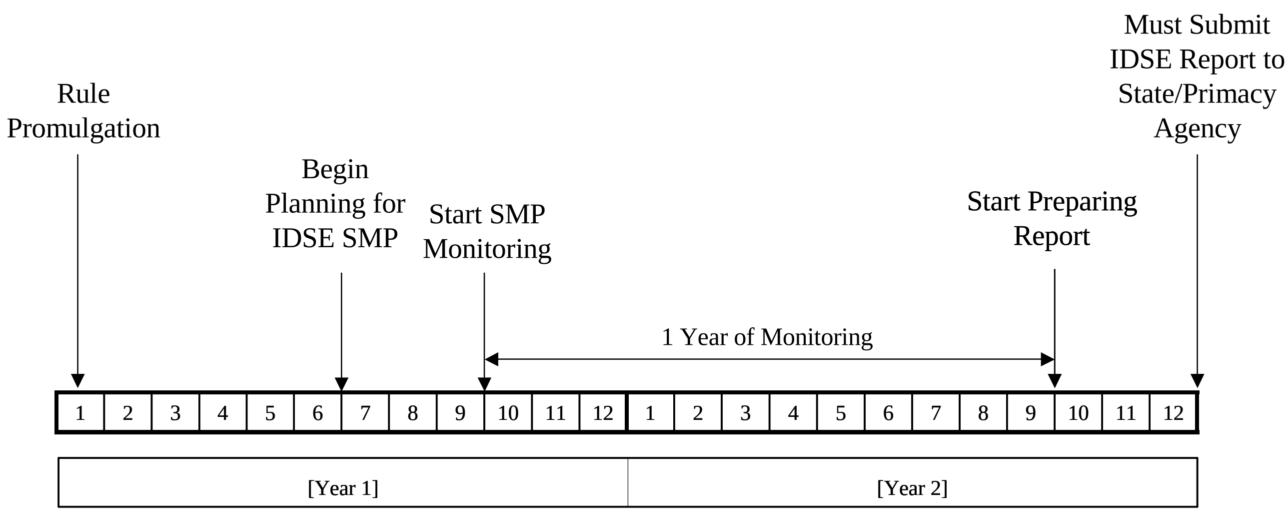
[2]Actual dates will be added in later drafts of this manual.

To ensure smooth execution of an SMP, planning should begin several months before the first sample date. An effective SMP plan includes, at a minimum—

- The number of required sample sites
- A sampling schedule
- The specific location of all selected SMP sample sites

Figure 2.1 below shows the recommended schedule for preparation and execution of an IDSE SMP to meet regulatory requirements.

Figure 2.1 Example Schedule for Conducting the IDSE SMP



[Actual timeline to be provided]

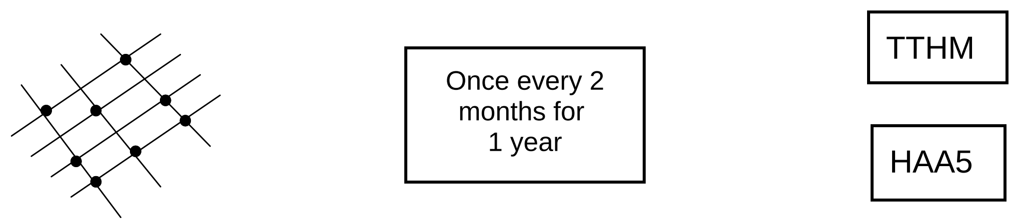
Considerations for Wholesaling Water Systems

If your system is a consecutive system or sells water to a consecutive system for at least 60 days of the year, not on an emergency basis, an IDSE report is due at the same time as for the largest system in the combined distribution system. For surface water systems serving 10,000 or more people, the IDSE report is always due [2 years after rule promulgation], regardless of the size of other systems in your combined distribution system.

If your system **sells** water to a consecutive system serving fewer than 10,000 people for at least 60 days per year, EPA recommends that you share information about your IDSE report schedule with the consecutive system (their report will also be due [2 years after rule promulgation] regardless of their system size). Notification to and coordination with systems that purchase water from your system is not required, but is encouraged.

2.3 Number of Samples Required

Subpart H systems serving 10,000 or more people must collect samples **every 2 months over a 1 year period**. (This sampling requirement is in addition to the Stage 1 compliance monitoring sites). Samples must be collected at **eight sites per plant** and analyzed for TTHM and HAA5. The TTHM and HAA5 samples are referred to as "dual samples," meaning two samples are collected at the same time at each site, one sample is analyzed for TTHM and one for HAA5. For a system with one plant, a total of **48 dual samples** are required (see the illustration below).



8 Sites per plant × 6 Sample Periods = 48 Dual Samples

Special Issues for Systems with More Than One Plant

The total number of samples that must be collected depends on how many plants are in the system. A plant can be defined as—

- A plant treating a subpart H source in the system
- A plant treating (or at minimum, adding a disinfectant except UV) a ground water source in the system
- An entry point where disinfected water from another system is delivered to the system (can be surface or ground water)

Systems may consider multiple wells drawing from a single aquifer as one plant (if they are disinfected with a disinfectant other than UV), with State approval.

In the Stage 2 DBPR, EPA defines a consecutive system entry point as a location at which finished water is delivered from a wholesale system to a consecutive system that buys some or all of its water, at least 60 days per year and not on an emergency basis. For the purposes of the IDSE, a consecutive entry point where finished water is delivered at least **90 days per year and not on an emergency basis** is considered to be one "plant."

An example of a more complicated system configuration is presented below—

- A subpart H system serving 10,000 or more people operates one surface water treatment plant and receives water from two disinfecting groundwater systems, at separate entry points, for more than 90 days per year. EPA considers this system as having three plants.

This system would be required to have 24 sample sites for the IDSE SMP (8 sites × 3 plants = 24 sites). This requirement applies regardless of the quantity of water purchased or produced at the plant.

2.4 Sample Location Requirements

Sample location requirements depend on a system's secondary disinfectant. Table 2.2 summarizes the IDSE SMP site location requirements for subpart H systems serving 10,000 or more people using chlorine or chloramines for secondary disinfection. The required SMP sample sites listed in Table 2.1 must be *in addition to* Stage 1 DBPR compliance monitoring locations. Chapter 5 provides guidance for selecting SMP sites to meet the requirements of the IDSE.

SMP sample sites must be **in addition** to your Stage 1 DBPR compliance monitoring sites.

Table 2.1 Number of SMP Sample Sites Required for Subpart H Systems Serving 10,000 or More People

Secondary Disinfectant Type	Number of SMP Sample Sites Required per Plant			
	High TTHM	High HAA5	Average Residence Time	Distribution System Entry Point
Chlorine	3	2	2	1
Chloramines	2	2	2	2

Special Issues for Systems with More Than One Plant

In systems with more than one plant, some areas of the distribution system can be served by one plant during one part of the year (e.g., spring, winter, and fall months) and another plant during another part of the year (e.g., summer months). In these cases, the required number of SMP sample sites for each plant should generally be located so that they represent *all* parts of the distribution system where the plant can potentially provide water (the influence zone of the plant). Although the plant may not be providing water to these sites all the time, SMP sampling locations should *not* be modified once sampling has begun (SMP sites should be fixed for the 1-year period).

Special issues for systems with temporary sources (less than 90 days)

If a system is supplemented by a **disinfecting ground water source** for less than 90 days of the year (i.e., a temporary source), typical water demand patterns in the influence zone of the temporary source should be considered when locating SMP sample sites. Consider the following situations—

- The temporary ground water source is providing water during the highest temperature month(s). In this case, an SMP site should not be located in the influence zone of the temporary source; focus should be on other areas of the distribution system.

- The temporary ground water source is *not* providing water during the highest temperature month(s). In this case, you may wish to locate SMP sites in the influence zones of your temporary source if you believe the area may represent a high TTHM or HAA5 location. You should be cognizant, however, of which source is providing the water that you are collecting during your SMP. If you collect a sample that is not representative of your surface water source, you should note this information on your IDSE report and consider not using the data when selecting final Stage 2B compliance monitoring sites (see Chapter 5 for guidelines for selecting Stage 2B monitoring sites).

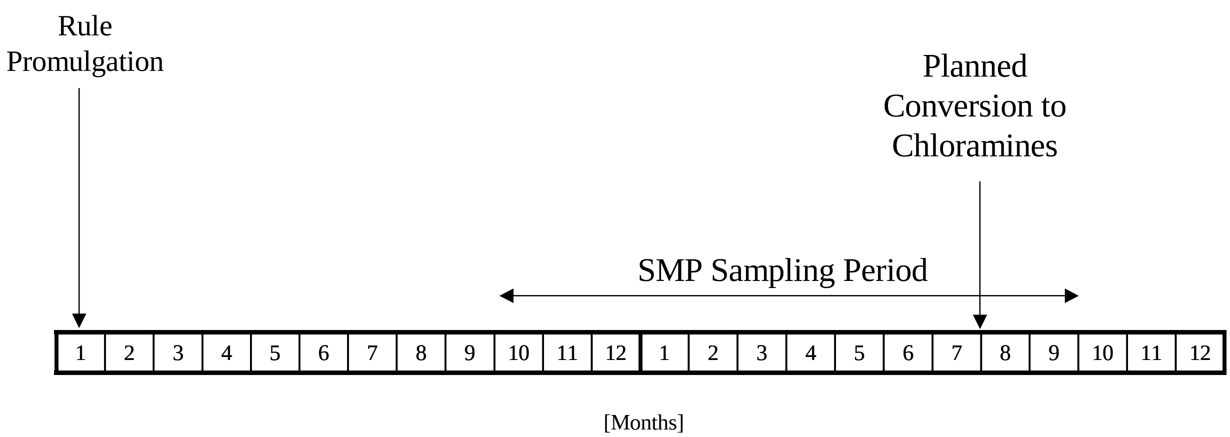
Special issues for systems that change disinfectants during the SMP period

If you anticipate a change in secondary disinfectant during the one year of SMP sampling, selection of SMP sites should be based on the disinfectant expected to be in use at the end of the sampling period. Figure 2.2 shows an example of a system using free chlorine that will change to chloramines before the end of the one-year SMP sampling period. Sample site selection should be performed as required for chloraminated systems. Thus, two sample sites (instead of one) near the entry point and four locations (instead of five) representative of highest TTHM and HAA5 should be selected.

If you are unsure as to whether your disinfectant conversion will take place, you should select sites based on SMP requirements for a *chlorine* system.

Figure 2.2 Planned Conversion to Chloramines

(SMP must be based on chloramine requirements.)



2.5 Timing of SMP Sample Collection

The system-specific monitoring schedule must be determined from historical DBP data. If your system does not have DBP data, then use distribution system water temperature data. The month with the highest TTHM/HAA5 level or maximum temperature is referred to as the *controlling month*. The other rounds of sampling must be scheduled at two month intervals based on the date you select for sample collection in the controlling month. The sampling dates for the entire year must be scheduled in advance. You can select a start date prior to the controlling month provided the controlling month is included in your schedule.

If the highest TTHM and HAA5 levels do not occur in the same month, your controlling month should be based on the month with the highest TTHM concentrations. Figure 2.3 and Table 2.2 provide an example of how to select the controlling month using hypothetical distribution system data.

Figure 2.3 Example Historic DBP and Temperature Data

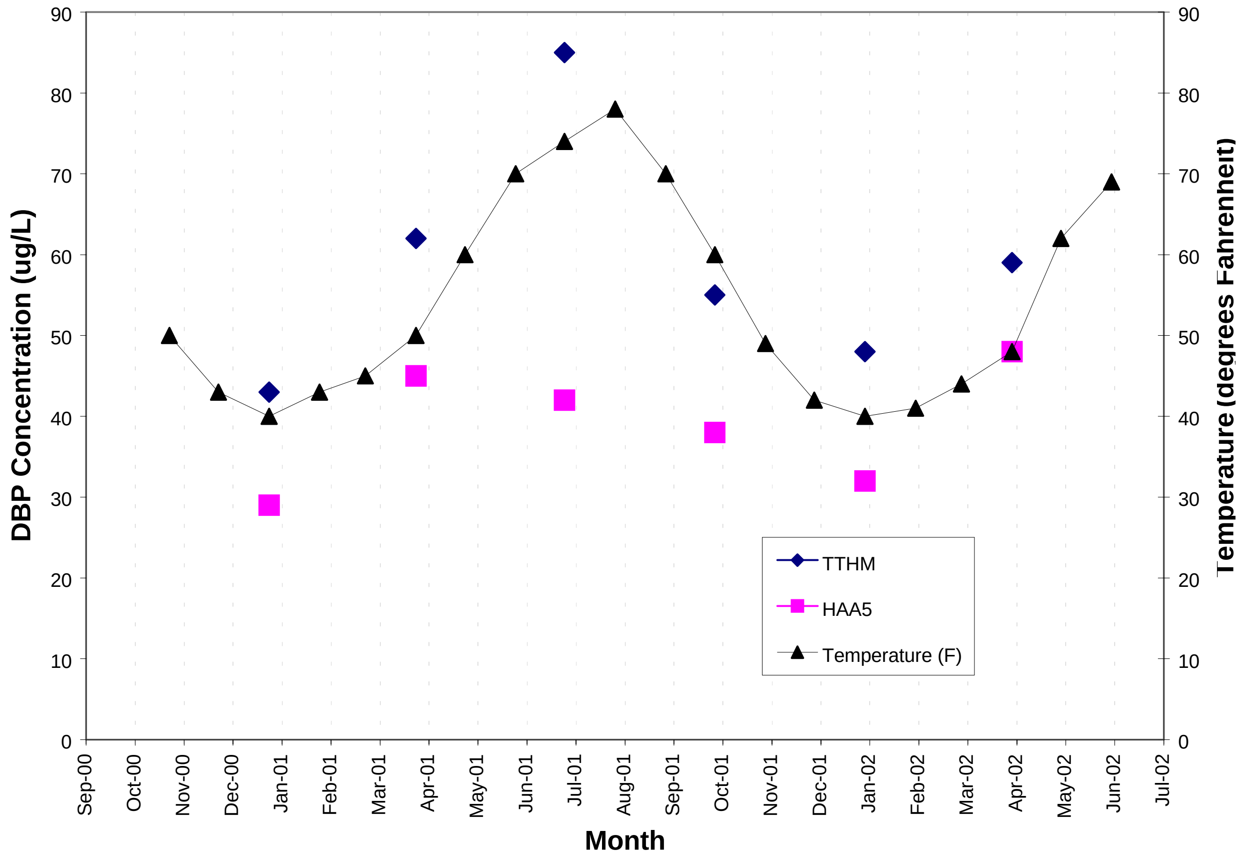


Table 2.2 Example of Historic DBP and Temperature Data

Month	Maximum Distribution System DBP Result (ug/L)[1]		Average Distribution System Temperature (F)
	TTHM	HAA5	
Nov-00			50
Dec-00			43
Jan-01	43	29	40
Feb-01			43
Mar-01			45
Apr-01	62	45	50
May-01			60
Jun-01			70
Jul-01	85	42	74
Aug-01			78
Sep-01			70
Oct-01	55	38	60
Nov-01			49
Dec-01			42
Jan-02	48	32	40
Feb-02			41
Mar-02			44
Apr-02	59	48	48
May-02			62
Jun-02			69

1. Highest results from four Stage 1 DBPR sampling locations. Maximum TTHM and HAA5 value does not necessarily have to be from the same sampling location

In this example, the highest DBP level was the TTHM concentration from July. Therefore the controlling month is July and the IDSE SMP sampling must be scheduled around that month. If no DBP data were available, August would have been selected as the controlling month because it has the highest average distribution system temperature.

For the example in Figure 2.3 and Table 2.2, the six sampling dates could be scheduled around the controlling month of July approximately every 60 days as follows—

- Sampling date in March 2003
- Same date in May 2003
- **Same date in July 2003** (controlling month)
- Same date in September 2003
- Same date in November 2003
- Same date in January 2004

Chloramine systems that routinely convert to chlorine for a certain time period (typically 1 to 2 weeks) must still set their schedule according to the highest DBP (or temperature) month, regardless of whether chloramine or chlorine is used during the controlling month. Consequently, sampling may or may not occur during chlorine use.

SMP samples should be collected during periods of normal system operation. The sample collection can be delayed several days (until conditions return to normal) in the following situations—

- Unusual raw water conditions, such as river flooding
- Unusual high system demands (e.g., such as a fire event or main break)

2.6 Sampling Protocol

Generally, it is best to collect samples in the morning to allow the samples to be packed and shipped the same day if sending them to a contract laboratory. Samples should be collected in a manner that ensures they are representative of the water in the distribution system at that sampling point. This means that the line between the sample tap/faucet and the distribution system should be flushed before the sample is collected. It can usually be accomplished by opening the faucet where the sample is collected and allowing the water to run for a few minutes. When the water temperature stabilizes, this indicates fresh water from the distribution system is being obtained.

Fire hydrants that impact the water reaching the sampling point should not be flushed prior to the collection of the DBP samples, because that would significantly change the “age” of the water being sampled. The intent of the DBP sampling effort is to obtain water that is representative of what the consumer normally receives.

The sample bottles should contain appropriate dechlorinating agents/preservatives prior to filling. Sampling and storage protocols outlined in the approved analytical methods must be followed. Contact the laboratory analyzing the samples for their recommended sampling and preservation protocols.

Continue to Chapter 5 for guidance on selecting SMP sites.

3.0 Standard Monitoring Program Requirements for: Subpart H systems Serving 500 to 9,999 People and Ground Water Systems Serving 10,000 or More People

3.1 Introduction

This chapter describes the IDSE Standard Monitoring Program (SMP) requirements for subpart H systems[1] serving 500 to 9,999 people and ground water systems serving 10,000 or more people. These requirements include monitoring schedule, frequency, and locations in the distribution system. Chapter 5 builds on this chapter by describing how to select SMP monitoring locations. The remainder of this chapter is organized as follows—

- 3.2 Schedule for Conducting the IDSE SMP
- 3.3 Number of Samples Required
- 3.4 Sample Location Requirements
- 3.5 Timing of Sample Collection
- 3.6 Sampling Protocol

Although some guidance in this chapter is appropriate for other system types and sizes, this chapter specifically addresses **subpart H systems serving 500 to 9,999 people and ground water systems serving 10,000 or more people**. Refer to Chapters 2 and 4 for guidance directed towards other source water types and system sizes.

3.2 Schedule for Conducting Your IDSE SMP

The IDSE report is due to your State [2 or 4 years after rule promulgation][2], depending on the size of the largest system in the combined distribution system (see Table 3.1). SMP sampling will take approximately 12 months. Analyses of the final round of samples, review of the results, the choice of new compliance sites, and completion of your report are estimated to take approximately 3 months. Therefore, it is recommended

> IDSE SMP sampling should begin [no later than *15 months* before your IDSE report is due].

[1] Subpart H systems use surface water or ground water under the direct influence of surface water as a source and are subject to the requirements of the Surface Water Treatment Rule.

[2] Actual dates will be added in later drafts of this manual.

that you begin IDSE SMP sampling [no later than 15 months before the IDSE report is due to your State].

Table 3.1 summarizes report due dates and SMP start dates according to system size.

Table 3.1 IDSE Report Schedule

System Type and Population Served	IDSE Final Report Due Date	Recommended SMP Sampling Start Date
Ground Water Systems Serving **≥ 10,000 People**	[2 years after rule promulgation]	[9 months after rule promulgation]
Subpart H Systems Serving **500 - 9,999 People**	[4 years after rule promulgation]	[2 years and 9 months after rule promulgation]
Subpart H Systems Serving **500 - 9,999 People** Subject to the Schedule of a System Serving **≥ 10,000 People**[1]	[2 years after rule promulgation]	[9 months after rule promulgation]

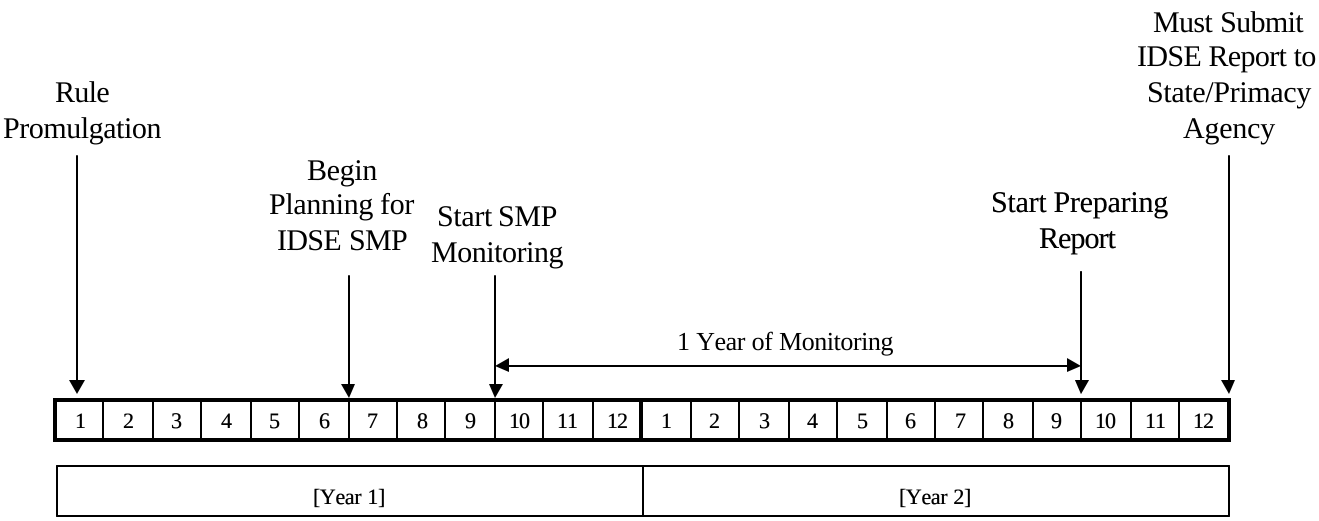
[1] If your system is a consecutive system or sells water to a consecutive system for at least 60 days of the year, not on an emergency basis, your IDSE report is due at the same time as for the largest system in the combined distribution system (i.e., if the largest system in the combined distribution system serves 10,000 or more people, your system is subject to the IDSE schedule for systems serving 10,000 or more people).

To ensure smooth execution of an SMP, you should begin planning several months before the first sample date. An effective SMP plan includes, at a minimum—

- The number of required sample sites
- A sampling schedule
- The specific location of all selected SMP sample sites

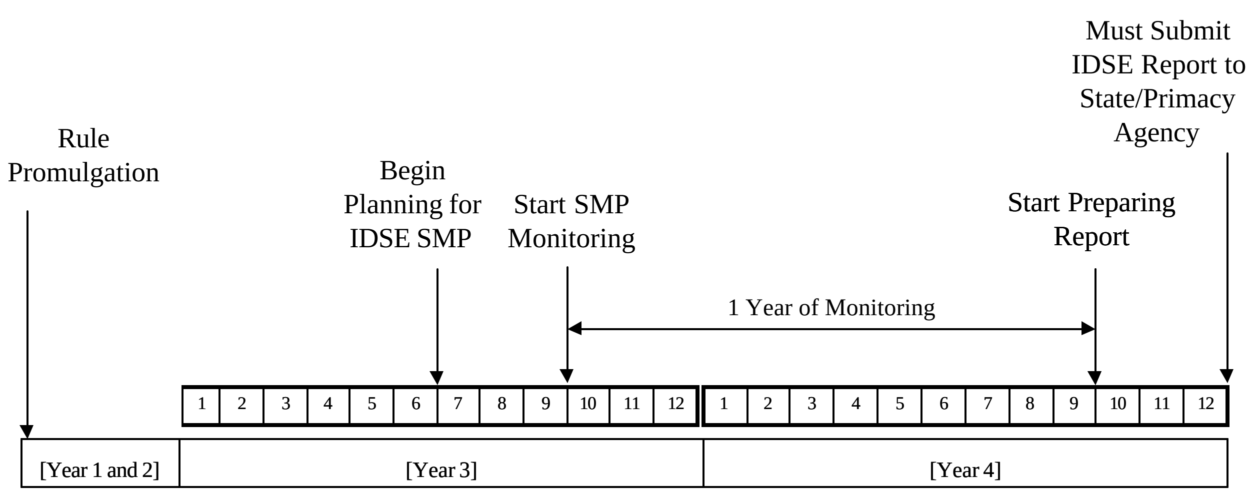
Figures 3.1 and 3.2 show the recommended schedules for preparing and executing an IDSE SMP if the largest system in the combined distribution system serves ≥ 10,000 people and if the largest system in the combined distribution system serving < 10,000 people, respectively.

Figure 3.1 Example Schedule for Conducting the IDSE SMP for Systems Serving 10,000 or More People



[Actual timeline to be provided]

Figure 3.2 Example Schedule for Conducting the IDSE SMP for Systems Serving Fewer than 10,000 People



[Actual timeline to be provided]

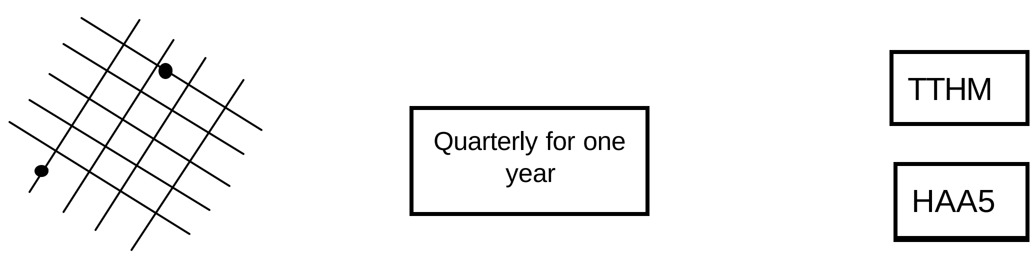
3.3 Number of Samples Required

Table 3.2 summarizes the number of sites, sampling frequency, and total number of samples that must be collected per plant in your system (this sampling requirement is in addition to the Stage 1 DBP compliance monitoring). All of your IDSE samples must be dual samples, meaning two samples are collected at the same time at each site and one is analyzed for TTHM and one for HAA5.

Table 3.2 Summary of SMP Sampling Requirements

System Type and Size	Number of Locations	Sampling Frequency	Total Dual Samples per Plant
Surface Water (500 - 9,999)	2 per treatment plant	every 3 months for one year	8
Ground Water (≥ 10,000)	2 per treatment plant	every 3 months for one year	8

For a subpart H systems serving 500 to 9,999 people and ground water system serving 10,000 or more people and having one plant, a total of 8 dual samples are required, and each must be analyzed for TTHM and HAA5 (see the illustration below).



2 Sites per plant × 4 Sample Periods = 8 Dual Samples

Special Issues for Systems with More Than One Plant

The total number of samples that you must collect depends on how many plants are in your system. A plant can be defined as—

- A plant treating a surface water source in your system

- A plant treating (or at minimum, adding a disinfectant except UV) a ground water source in your system
- An entry point where disinfected water from another system is delivered to your system (can be ground or surface water)

Systems may consider multiple wells drawing from a single aquifer as one plant (if they are disinfected with a disinfectant other than UV), with State approval.

In the Stage 2 DBPR, EPA defines a consecutive system entry point as a location at which finished water is delivered from a wholesale system to a consecutive system that buys some or all of its water, at least 60 days per year and not on an emergency basis. For the purposes of the IDSE, a consecutive entry point where finished water is delivered at least **90 days per year and not on an emergency basis** is considered to be one "plant."

An example of a more complicated system configuration is presented below—

- A subpart H system serving 500 to 9,999 people operates one surface water treatment plant, one ground water treatment plant, and purchases water for more than 90 days a year from another subpart H system. EPA considers this system as having <u>three</u> plants.

This system would be required to have <u>6 sample sites</u> for the IDSE SMP (2 sites × 3 plants = 6 sites). This requirement applies regardless of the quantity of water purchased or produced at the plant.

3.4 Sample Location Requirements

Table 3.2 summarizes the IDSE SMP site location requirements for subpart H systems serving 500 to 9,999 people and ground water systems serving 10,000 or more people. The required SMP samples must be collected at the sites listed in Table 3.2 *in addition to* samples collected at Stage 1 DBPR monitoring locations. Chapter 5 provides guidance for selecting SMP sites to meet the requirements of the IDSE.

> SMP sample sites must be **in addition** to your Stage 1 DBPR compliance monitoring sites.

Table 3.3 Requirements for the Number of SMP Sample Sites

System Type and Size	Number of SMP Sample Sites Required per Plant		
	High TTHM	High HAA5	Total SMP Sites
Surface water (500-9,999)	1	1	2
Ground water ($\geq$ 10,000)	1	1	2

Special issues for systems with temporary sources (less than 90 days)

If you are a subpart H system serving 500 - 9,999 people that is supplemented by a **disinfecting ground water source** for less than 90 days of the year (i.e., a temporary source), you should consider typical water demand patterns in the influence zone of the temporary source when locating your SMP sample sites. Consider the following situations—

- The temporary ground water source is providing water during your highest temperature month(s). In this case, you should not locate an SMP site in the influence zone of the temporary source but focus on other areas of the distribution system.

- The temporary ground water source is *not* providing water during your highest temperature month(s). In this case, you may wish to locate SMP sites in the influence zones of your temporary source if you believe the area may represent a high TTHM or HAA5 location. You should be cognizant, however, of which source is providing the water that you are collecting during your SMP. If you collect a sample that is not representative of your surface water source, you should note this information on your IDSE report and consider not using the data when selecting final Stage 2B compliance monitoring sites (see Chapter 5 for guidelines for selecting Stage 2B monitoring sites).

If you are a **ground water system** serving 10,000 or more people that is supplemented with a temporary **surface water source**, your SMP sites should be in the influence zone(s) of the temporary surface water source and sampling should occur when the temporary surface water source is providing water.

- For example, a ground water system serving 10,000 or more people has one treatment plant and buys treated surface water during their peak demand month through a single entry point. For purposes of the IDSE, this system has one "plant" and the location of one of their two SMP sample sites must be in the influence zone of the purchased surface water and sampling should occur when they are distributing the surface water.

3.5 Timing of Sample Collection

The system-specific monitoring schedule must be determined from historical DBP data. If your system does not have DBP data, then use distribution system water temperature data. The month with the highest TTHM/HAA5 level or maximum temperature is referred to as the *controlling month.* The other rounds of sampling must be scheduled at three month intervals based on the date you select for sample collection in the controlling month. The sampling dates for the entire year must be scheduled in advance. You can select a start date prior to the controlling month provided the controlling month is included in your schedule.

If the highest TTHM and HAA5 levels do not occur in the same month, your controlling month should be based on the month with the highest TTHM concentrations. Figure 3.3 and Table 3.4 provide an example of how to select the controlling month using hypothetical distribution system data.

Figure 3.3 Example Historic DBP and Temperature Data

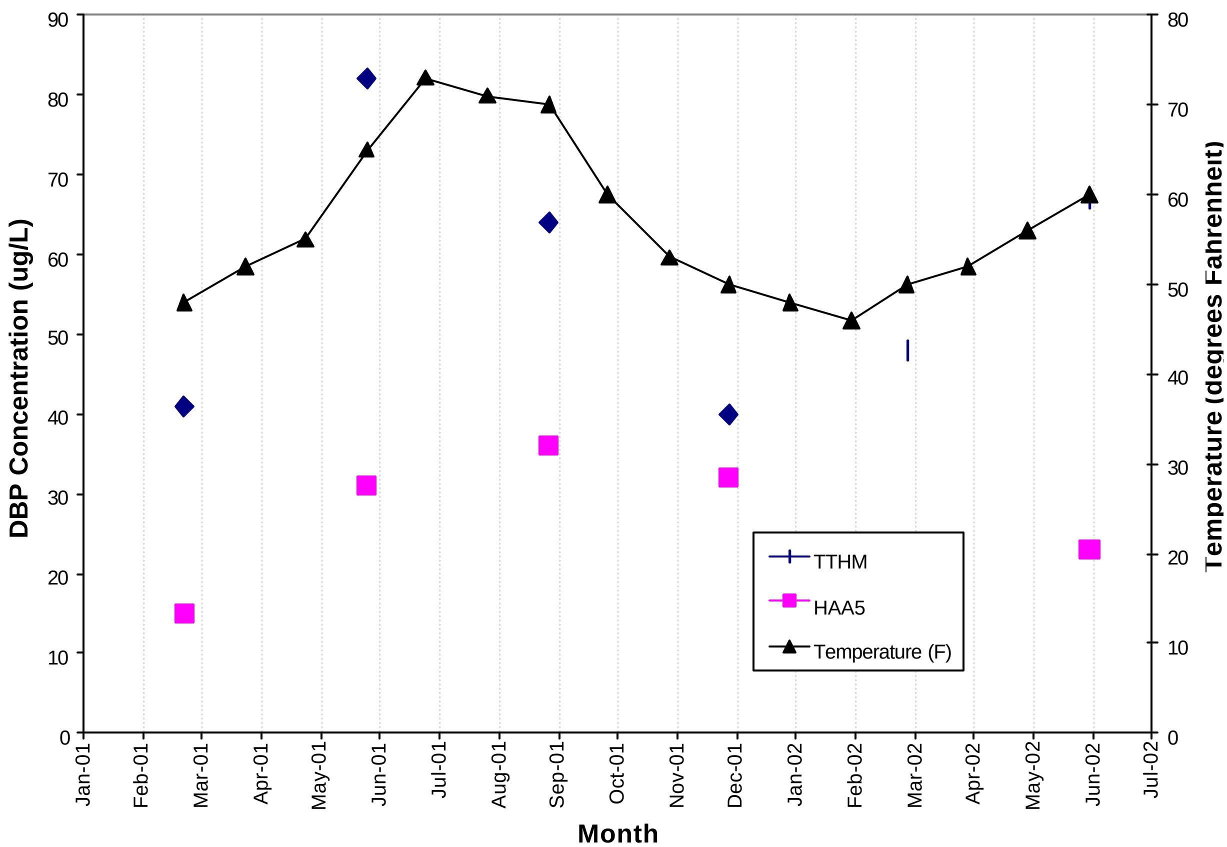


Table 3.4 Example of Historic TTHM and Temperature Data

Month	Distribution System DBP Monitoring Results (ug/L)		Average Distribution System Temperature (F)
	TTHM	HAA5	
Mar-01	41	15	48
Apr-01			52
May-01			55
Jun-01	82	31	65
Jul-01			73
Aug-01			71
Sep-01	64	36	70
Oct-01			60
Nov-01			53
Dec-01	40	32	50
Jan-02			48
Feb-02			46
Mar-02	48	20	50
Apr-02			52
May-02			56
Jun-02	67	23	60

In this example, the highest DBP level was the TTHM concentration from June. Even though the high HAA5 and maximum temperature occurred in different months, you should still select the controlling month of June because it has the highest TTHM concentration. If no DBP data were available, July would have been selected as the controlling month because it has the highest average distribution system temperature. For this example, the four sampling dates could be scheduled around the controlling month of June approximately every 90 days.

Chloramine systems that routinely convert to chlorine for a certain time period (typically 1 to 2 weeks) must still set their schedule according to the highest DBP (or temperature) month, regardless of whether chloramine or chlorine is used during the controlling month. Consequently, sampling may or may not occur during chlorine use.

SMP samples should be collected during periods of normal system operation. The sample collection can be delayed several days (until conditions return to normal) in the following situations—

- Unusual raw water conditions, such as river flooding
- Unusual high system demands (e.g., such as a fire event or main break)

3.6 Sampling Protocol

Generally, it is best to collect samples in the morning to allow the samples to be packed and shipped the same day if sending them to a contract laboratory. Samples should be collected in a manner that ensures they are representative of the water in the distribution system at that sampling point. This means that the line between the sample tap/faucet and the distribution system should be flushed before the sample is collected. It can usually be accomplished by opening the faucet where the sample is collected and allowing the water to run a few minutes. When the water temperature stabilizes, this indicates fresh water from the distribution system is being obtained.

Fire hydrants that impact the water reaching the sampling point should not be flushed prior to the collection of the DBP samples, because that would significantly change the "age" of the water being sampled. The intent of the DBP sampling effort is to obtain water that is representative of what the consumer normally receives.

The sample bottles should contain appropriate dechlorinating agents/preservatives prior to filling. Sampling and storage protocols outlined in the approved analytical methods must be followed. Contact the laboratory analyzing the samples for their recommended sampling and preservation protocols.

Continue to Chapter 5 for guidance on selecting SMP sites.

4.0 Standard Monitoring Program Requirements for: Subpart H Systems Serving Fewer Than 500 People and Ground Water Systems Serving Fewer Than 10,000 People

4.1 Introduction

Subpart H systems serving fewer than 500 people and ground water systems serving fewer than 10,000 people **are not required to conduct an IDSE** if they meet one or more of the following criteria—

- For systems serving fewer than 500 people, the State can issue a waiver because both your high TTHM and high HAA5 occur at your Stage 1 DBPR compliance monitoring site.

- All compliance samples from [the previous two years][1] are ≤ 40 ug/L for TTHM and ≤ 30 ug/L for HAA5.

- System is a nontransient noncommunity (NTNCWS) water system.

Chapter 1, Section 1.3 of this report has additional information on requirements for obtaining an exemption or waiver from IDSE requirements. Although systems may not have to conduct an IDSE, they may be required to evaluate Stage 1 DBPR sites to determine if they meet requirements of the Stage 2 DBPR. Refer to Chapter 7 for requirements for systems that are not conducting an IDSE.

If required to conduct an IDSE, you may perform the Standard Monitoring Program (SMP) or complete an alternative System-Specific Study (SSS). This chapter describes the IDSE SMP requirements, including monitoring, schedule, frequency, and locations. The remainder of this chapter is organized as follows—

4.2 Schedule for Conducting the IDSE SMP
4.3 Number of Samples Required
4.4 Sampling Location Requirements
4.5 Timing of Sample Collection
4.6 Sampling Protocol

[1]Actual dates will be added in later drafts of this manual

4.2 Schedule for Conducting the IDSE SMP

> IDSE SMP sampling should begin [no later than *15 months* before the IDSE report is due.]

The IDSE report is due to your State [2 or 4 years after rule promulgation], depending on system size, and on the size of the largest system in your combined distribution system (see Table 4.1). SMP sampling takes approximately 12 months. Therefore, it is recommended that you begin IDSE SMP sampling [no later than 15 months before the IDSE report is due to your State]. The additional three months will allow time for the final round of samples to be analyzed, the results of the sampling to be reviewed, new compliance sites to be chosen, and your report to be completed.

Table 4.1 summarizes report due dates and SMP start dates according to system size and type of source water.

Table 4.1 IDSE Report Schedule

System Type and Population Served	IDSE Final Report Due Date	Recommended SMP Sampling Start Date
Ground Water Systems Serving **< 10,000 People**	[4 years after rule promulgation]	[2 years and 9 months after rule promulgation]
Subpart H Systems Serving **< 500 People**	[4 years after rule promulgation]	[2 years and 9 months after rule promulgation]
Subpart H Systems Serving **< 500 People** and Ground Water Systems Serving **< 10,000 People** Subject to the Schedule of a System Serving **$\geq$ 10,000 People**[1]	[2 years after rule promulgation]	[9 months after rule promulgation]

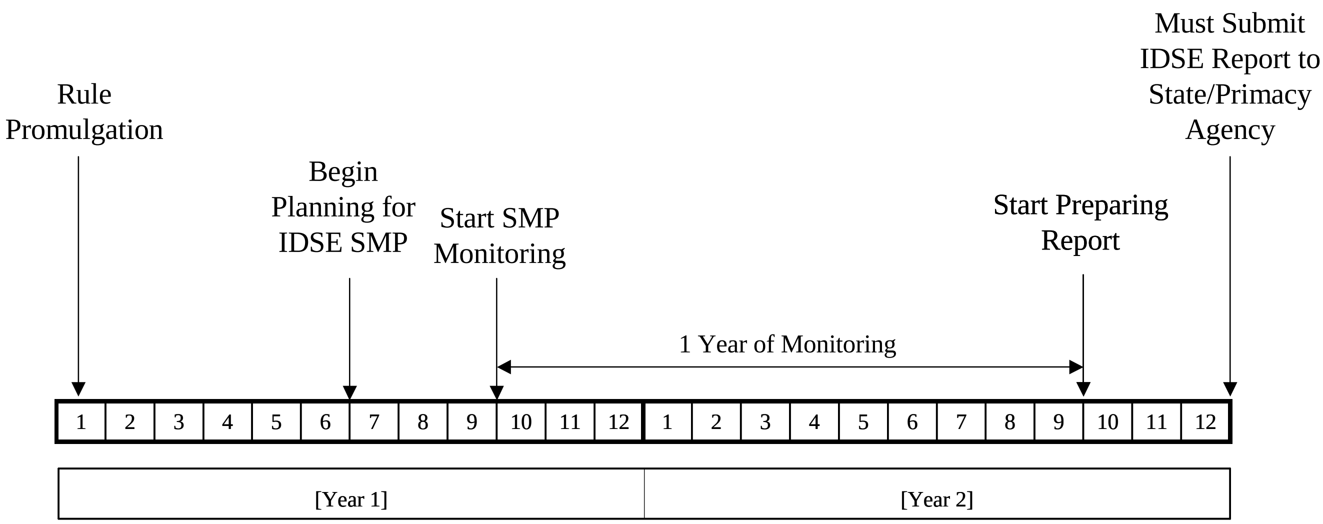
[1] If your system is a consecutive system or sells water to a consecutive system for at least 60 days of the year, not on an emergency basis, your IDSE report is due at the same time as for the largest system in the combined distribution system. (i.e., if the largest system in the combined distribution system serves 10,000 or more people, your system is subject to the IDSE schedule for systems serving 10,000 or more people). If you are a consecutive system and do not know the population served by the largest system, contact your provider.

To ensure smooth execution of an SMP, planning should begin several months before the first sample date. An effective SMP plan includes, at a minimum—

- The number of required sample sites
- A sampling schedule
- The specific location of all selected SMP sample sites

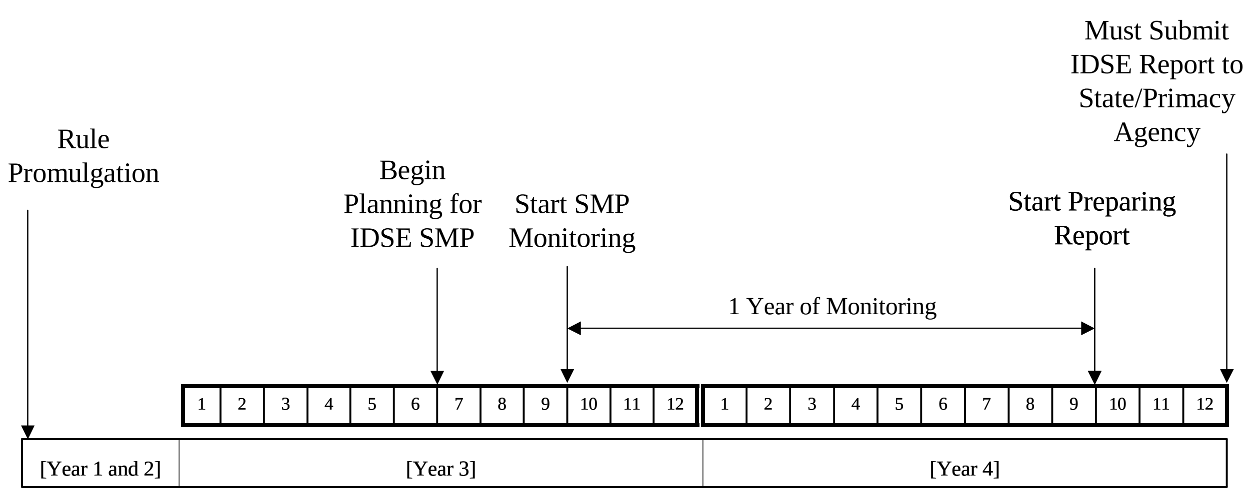
Figures 4.1 and 4.2 show the recommended schedules for preparing and executing an IDSE SMP if the largest system in the combined distribution system serves $\geq$ 10,000 people and if the largest system in the combined distribution system serving < 10,000 people, respectively.

Figure 4.1 Example Schedule for Conducting the IDSE SMP for Systems Serving 10,000 or More People



[Actual timeline to be provided]

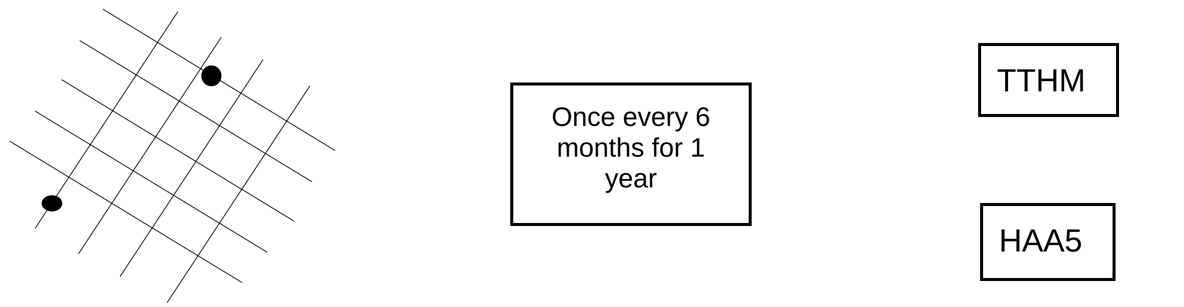
Figure 4.2 Example Schedule for Conducting the IDSE SMP for Systems Serving Fewer than 10,000 People



[Actual timeline to be provided]

4.3 Number of Samples Required

Subpart H systems serving fewer than 500 people and ground water systems serving fewer than 10,000 people must collect samples **every 6 months over a one-year period** (this sampling requirement is in addition to Stage 1 DBPR monitoring). Samples must be collected at two sites per plant and analyzed for TTHM and HAA5. The TTHM and HAA5 samples are referred to as "dual samples," meaning two samples are collected at each site for each sample period and one is analyzed for TTHM and one for HAA5. For these systems having one plant, a total of 4 dual samples are required, and each should be analyzed for TTHM and HAA5 (see the illustration below).



2 Sites per Plant × 2 Sample Periods = 4 Dual Samples

Special Issues for Systems with More Than One Plant

The total number of samples that you must collect depends on how many plants are in your system. A plant can be defined as—

- A plant treating a subpart H source in your system
- A plant treating (or at minimum, adding a disinfectant except UV) a ground water source in your system
- An entry point where disinfected water from another system is delivered to your system

Systems may consider multiple wells drawing from a single aquifer as one plant (if they are disinfected with a disinfectant other than UV), with State approval.

In the Stage 2 DBPR, EPA defines a consecutive system entry point as a location at which finished water is delivered from a wholesale system to a consecutive system that buys some or all of its water, at least 60 days per year and not on an emergency basis. For the purposes of the IDSE, a consecutive entry point where finished water is delivered at least **90 days per year and not on an emergency basis** is considered to be one "plant."

An example of a more complicated system configuration is presented below—

- A ground water system serving fewer than 10,000 people operates one ground water treatment plant and receives water from two disinfecting groundwater systems, at separate entry points, for more than 90 days per year. EPA considers this system as having <u>three</u> plants.

This system would be required to have 6 sample sites for the IDSE SMP (2 sites × 3 plants = 6 sites). This requirement applies regardless of the quantity of water purchased or produced at the plant.

4.4 Sample Location Requirements

You must select two SMP sample sites per plant, meeting the following criteria—

- One site representative of the highest TTHM concentration in your system
- One site representative of the highest HAA5 concentration in your system
- Sites must be different than your Stage 1 DBPR monitoring sites

These required SMP sites must be in addition to your Stage 1 DBPR monitoring site. In many small systems, the highest HAA5 concentration would be expected to occur at the same location as the highest TTHM concentration. However, in some systems (often those with low disinfectant residual levels and high maximum water age) the HAA5 concentration can decrease in some parts of the distribution system. Chapter 5 provides guidance for selecting SMP sites to meet the requirements of the IDSE.

> SMP sample sites must be **in addition** to your Stage 1 DBPR compliance monitoring sites.

4.5 Timing of Sample Collection

One of your sampling dates must occur in the month with the highest water temperature in your distribution system (you should already be taking your Stage 1 DBPR compliance samples during this month). Your other sampling date must be 6 months before or after the high distribution system water temperature month. The 6-month interval should be maintained as closely as possible. SMP samples should be collected during periods of normal system operation. The sample collection can be delayed several days (until conditions return to normal) in the following situations—

- Unusual raw water conditions, such as river flooding
- Unusual high system demands (e.g., such as a fire event or main break)

This regimen is expected to typically result in one sample date occurring in the summer (July through September), and the second in the winter (January-March).

4.6 Sampling Protocol

Generally, it is best to collect samples in the morning to allow the samples to be packed and shipped the same day if sending them to a contract laboratory. Samples should be collected in a manner that ensures they are representative of the water in the distribution system at that sampling point. This means that the line between the sample tap/faucet and the distribution system should be flushed before the sample is collected. It can usually be accomplished by opening the faucet where the sample is collected and allowing the water to run a few minutes. When the water temperature stabilizes, this indicates fresh water from the distribution system is being obtained.

Fire hydrants that impact the water reaching the sampling point should not be flushed prior to the collection of the DBP samples, because that would significantly change the “age” of the water being sampled. The intent of the DBP sampling effort is to obtain water that is representative of what the consumer *normally* receives.

The sample bottles should contain appropriate dechlorinating agents/preservatives prior to filling. Sampling and storage protocols outlined in the approved analytical methods must be followed. Contact the laboratory analyzing the samples for their recommended sampling and preservation protocols.

Continue to Chapter 5 for guidance on selecting SMP sites.

5.0 Standard Monitoring Program

5.1 Introduction

The Standard Monitoring Program (SMP) is a one-year monitoring program designed to generate data that are sugsequently used to select Stage 2B DBPR compliance monitoring sites that better capture representative high TTHM and HAA5 concentrations. Chapters 2, 3, and 4 of this manual provide detailed requirements for conducting the IDSE Standard Monitoring Program (SMP) for various system sizes and source water types. This chapter, which applies to *all* system sizes and source types, builds on chapters 2, 3, and 4 by providing guidance for selecting IDSE SMP monitoring sites using various tools. This chapter also contains detailed guidance for selecting Stage 2B compliance monitoring sites based on the results of the IDSE SMP and provides templates and examples for preparing the IDSE SMP report.

The remainder of this chapter is organized as follows–

5.2 Description of IDSE SMP Sites
5.3 Data Sources and Tools For Identifying Preliminary SMP Sites
5.4 Using Multiple Data Sources and Tools to Select Final SMP Sites
5.5 Using SMP Results to Select Stage 2B Compliance Monitoring Sites
5.6 Minimum Requirements For IDSE Reports

5.2 Description of IDSE SMP Sites

A summary of the SMP sample site requirements according to system size and source water type is presented in Table 1.1 (page 1-3). As shown in the table, there are four possible types of sampling locations required for the IDSE SMP: entry point, average residence time, high TTHM, and high HAA5 locations. A description of each is provided in Sections 5.2.1 through 5.2.3.

5.2.1 Entry Point Sites

Chlorine systems are required to select one entry point SMP site per plant. Although entry points are generally defined as the location where finished water leaves the treatment plant, systems may want to consider locating entry point SMP sample sites near the first group of customers. Data collected from entry point sites close to the first customer may more accurately characterize DBP exposure to customers.

Chloramine systems must select two entry point sites per plant for the SMP. To avoid locating the sampling sites too close to one another, chloramine systems should select sites (1) between the entry point to the distribution system and the first customer and (2) after the first customer.

If a transmission line splits before the first group of customers, systems should select sites on different branches.

As noted in Chapters 2, 3, and 4 (particularly, sections 2.3, 3.3, and 4.3), SMP requirements are on a per-plant basis. If you purchase disinfected water for more than 90 days per year, the location where the finished water enters the system is considered one plant. Thus, entry point SMP sites for that plant must be located near where the purchased water enters the system. Multiple groundwater wells drawing from one aquifer and delivering disinfected water directly to the distribution system may be considered as a single plant with approval from the State. Any of the locations near the first group of customers of each well are acceptable entry point sample sites.

5.2.2 Average Residence Time Sites

Sites with average residence time are intended to represent the overall, average water age in the distribution system. This *does not* mean an area where the water is one-half the age of water at the system's maximum residence time area. An estimation of the average age of water in a system should be made based on a flow or demand weighted assessment of water age. This assessment may result in the selection of a location with a residence time that could be more or less than half of the maximum residence time of the system.

5.2.3 High TTHM and High HAA5 Sites

TTHM and HAA5 are the products of disinfectants reacting with organic and inorganic materials in water. Higher temperatures and increased residence time lead to higher TTHM and HAA5 concentrations. However, HAA5 can biodegrade when no residual disinfectant is present. These principles are the basis for the guidance provided in selecting high TTHM and high HAA5 SMP sites. Table 5.1 summarizes the distribution system characteristics of the high TTHM and HAA5 sites.

Due to the complex nature of distribution systems (e.g., non-uniform mixing, biofilm growth), the formation of DBPs in distribution systems is system-specific. Therefore, the guidance provided in this manual may not apply to every system and best professional judgement should always be used. Appendix A contains more detailed information on TTHM and HAA5 formation and control.

Table 5.1 Summary of SMP Site Characteristics

Site	Characteristics
High TTHM	Long residence time -remote areas with few customers -low or no disinfectant residual (also high heterotrophic plant count [HPC] or positive coliform) -after storage facilities -areas with historical data showing high TTHM
High HAA5	-Residence time can vary -Low but positive disinfectant residual (to prevent biodegradation)

High TTHM and high HAA5 SMP results should represent the maximum DBP concentrations in finished water that is **delivered to customers**. Large, dead-end water mains with only a few customers, especially if they are located in remote areas of the distribution system, are likely to have high TTHM concentrations. Dead-end mains with no service, however, should not be evaluated for your IDSE SMP since a customer never consumes this water.

5.3 Data Sources and Tools for Identifying Preliminary SMP Sites

Several sources of information are available to help you select SMP sample sites that represent average residence times and sites that have the highest TTHM/HAA5 concentrations. For example, chlorine residual data can be a good indication of water residence time, and the site of maximum residence time is very often the site of maximum TTHM concentration. This section describes the following types of information and how they can be used in selecting preliminary SMP sample sites—

- Maps
- Distribution system water quality data
- Distribution system hydraulic model
- Tracer study results
- Simulated Distribution System (SDS) laboratory test
- System operating data
- Geographic Information System (GIS)

Section 5.4 draws on information presented in this section to derive step-by-step methodologies from data sources to select final SMP sites.

5.3.1 Maps

Map features that may be helpful in selecting SMP sites include—

- Length and diameter of pipes
- Age of pipes
- Pressure zone delineations
- Location of distribution system pumping stations
- Location and configuration of storage facilities
- Location of fire hydrants
- Existing land use
- Population density

These features can help identify areas of high and average residence times. Areas with higher residence times usually have high TTHMs.

1) <u>High TTHM and HAA5 Sites</u>

Remote areas

Generally, areas with light development or low residential population density that are furthest away from the treatment plant(s) are likely to have the longest residence times and therefore, potentially high TTHM and HAA5 concentrations.

In general, sites at the *very* end of a distribution system main with no customers should not be selected—

- In many distribution systems, there may be no customers at the actual physical end of some dead-end sections of a water main. Water quality at this type of location is not truly “representative” of water that is provided to customers upstream of the dead-end.

- Sample sites should be chosen near the end of the distribution system at the last group of customers, but not past the last fire hydrant.

Blending zones

In some cases, there can be zones in the distribution system where water flowing from opposite directions meet. This can occur in—

- Any main when demand and flow changes
- Long, looping mains
- The interface of the influence zones of two or more different supply points
- Areas where different pressure zones meet within one system

This type of area is sometimes called a “blending zone” or a hydraulic dead-end. Blending zones can occur anywhere in the distribution system, but they more often occur in the central portion of a distribution system. If the water demand around the blending zone is low, then the water age and TTHM and HAA5 concentrations could be high.

Storage Facilities

Storage facilities in a distribution system increase water age. Areas of a distribution system that receive water that has been stored may have higher TTHM concentrations than areas that do not receive any stored water.

2) <u>Average Residence Time Sites</u>

Average residence time is achieved once half of the water that enters the distribution system is consumed. Average residence time areas can often be identified by reviewing maps of the distribution system and service area to identify areas with the most development. If a few large customers exist in a system, then their location should be identified and the effect of water flowing to them taken into consideration.

5.3.2 Distribution System Water Quality Data

Systems routinely sample for various water quality parameters as required by regulations or for operational purposes. A review of your recent historical DBP and disinfectant residual data (free chlorine or chloramine) can be very useful in the selection of preliminary SMP sample sites.

5.3.2.1 Disinfectant Residual Data

Because chlorine and chloramines decay over time, lower disinfectant residuals can generally be interpreted to mean greater water age. A review of disinfectant residual data from your existing distribution system monitoring sites can help identify the areas of your system with the highest residence time and those with average residence time. Sources of disinfectant residual data may include regular compliance monitoring sites (e.g., Surface Water Treatment Rule (SWTR) or Stage 1 DBPR monitoring sites), operational sample sites, or special sites sampled in response to customer complaints. Combining the data from these various sample sites may help you better understand the change in disinfectant residual as water flows through your distribution system and, consequently, help you choose the required SMP sample sites.

There are cases, however, where lower disinfectant residuals do not necessarily indicate greater water age. Common factors that can influence disinfectant residual decay and affect the relationship between residual levels and water age are—

- Pipe material and internal lining
- Corrosion condition in the pipe
- Biofilm growth in the pipe
- Accumulation of sediment in the pipe
- Booster disinfection

Generally, booster disinfection is practiced in distribution systems with long residence times to maintain disinfectant residual in areas far from the treatment plant. If your system uses booster disinfection continuously or intermittently, you should consider the location of the booster disinfection stations when reviewing your residual data. High TTHM and HAA5 sites should be after the booster disinfection station(s).

If your system does not have much disinfectant residual data, or if you are not able to identify sites with average or high residence times based on your existing data, you may want to collect additional disinfectant residual data from your system to better characterize your system and select SMP sites.

1) <u>High TTHM and HAA5 Sites</u>

Low disinfectant residual relative to system average

Low disinfectant residuals relative to the system average generally indicate longer residence times, which usually correlates with higher TTHM and HAA5 concentrations. Very low or no disinfectant residual, however, could indicate biological decay of HAA5, and should generally not be chosen as your high HAA5 site.

- When selecting preliminary high HAA5 sites, locations with residual chlorine <u>less than 0.2 mg/L and chloramine less than 0.5 mg/L</u> should not be selected because of the potential for HAA5 biodegradation.

- High HAA5 sites should have no significant increase in recorded heterotrophic plate counts (HPCs) to ensure a low potential for HAA5 biodegradation. If you have HPC data, a comparison of disinfectant residual and these data can help you more precisely determine the threshold disinfectant residual below which HPC levels begin to increase.

Review disinfectant residual data from the warmer months

Because disinfectant residuals typically decay faster during the summer, a review of data from the summer months may be more useful in identifying areas with consistently low residuals. During the winter, disinfectants are usually more persistent, and residuals can often be maintained in relatively old water within a distribution system. The correlation between residence time and residual decay is less pronounced in the colder months.

2) <u>Average Residence Time Sites</u>

Estimating average disinfectant residual in your distribution system can help identify locations with average water residence time. When calculating average disinfectant residual, it is important that you use data from sites that are representative of your entire distribution system. One way to do this is to limit data to those collected at your Total Coliform Rule (TCR) monitoring sites (the TCR requires that all monitoring sites combined represent the distribution system). Use of historical data or other data (e.g., data from customer complaints) could skew the results by having more data in a given area.

Assuming your disinfectant residual data are representative of your distribution system, the following analysis from SWTR and Stage 1 DBPR monitoring data can be used to identify sites with average residence time—

1. Calculate an average disinfectant residual at each of your SWTR or Stage 1 DBPR residual disinfectant sites using data from your warmest months (chlorine decay is more pronounced in warmer temperatures so you are more likely to see larger changes in chlorine residual from one point to the next).

2. Using averages from the individual sites, calculate an overall distribution system average residual concentration.

3. Those sites with an average residual close to the distribution system average can be considered representative of average residence time in the distribution system.

Table 5.2 shows an example of this analysis for a system with June, July, and August as their warmest months. Note that sites #2, #3, and #9 have average chlorine residual concentrations close to the system average.

Table 5.2 Example of System Average Disinfectant Residual Calculation

Site ID	Monthly Average (mg/L)			Site Average (mg/L)
	Jun	Jul	Aug	
#1	1.4	1.3	1.6	1.4
#2	***0.7***	***0.9***	***0.7***	***0.8***
#3	***1.0***	***0.9***	***1.2***	***1.0***
#4	0.6	0.6	0.7	0.6
#5	0.9	1.2	1.4	1.2
#6	0.4	0.5	0.4	0.4
#7	0.2	0.3	0.6	0.4
#8	1.5	1.7	1.7	1.6
#9	***0.9***	***0.7***	***0.8***	***0.8***
#10	0.5	0.3	0.8	0.5
Distribution System Ave	**0.8**	**0.8**	**1.0**	**0.9**

5.3.2.2 DBP Data

DBP (TTHM or HAA5) samples in addition to the required Stage 1 DBPR compliance samples can be very important in selecting high TTHM and HAA5 sites. *However, sites used for compliance with the Stage 1 DBPR cannot be used as SMP sites*. For surface water systems, historical DBP data should be evaluated with respect to raw water quality conditions before and during the sampling period (e.g., changes in TOC concentration from year to year can significantly affect DBP levels). Further, DBP data should not be used as a proxy for estimating average residence time because DBP formation is complex and dependent on many factors.

If your system has extensive TTHM and HAA5 data at a variety of sites throughout your distribution system, you may wish to consider completing a System Specific Study (SSS) based on your historical data, possibly with a limited amount of new testing. TTHM and HAA5 data must meet many requirements, including results being generated by a laboratory certified to perform these analyses. Chapter 6 further describes the requirements of an SSS using historical DBP data.

1) <u>High TTHM and HAA5 Sites</u>

Historical DBP data (in addition to data collected under the Stage 1 DBPR) are not a definitive source for identifying the true highest TTHM concentrations. There may be other areas with higher DBPs that were not sampled or did not have high results due to changes in flow or water quality at the time of sampling. Therefore, historical data should be used in conjunction with residence time information or results from a Simulated Distribution System (SDS) test. (Section

5.3 describes the SDS test and Section 5.4 describes how to evaluate combinations of different types of data.)

Good candidates for high TTHM and HAA5 sites include—

- Historic sample sites with high TTHM concentrations in areas with long residence times

- Historic sample sites with high HAA5 concentrations in areas that consistently maintain a disinfectant residual

- Historic sample sites with TTHM/HAA5 concentrations that are close to the TTHM/HAA5 concentration from an SDS test for maximum residence time

5.3.3 Simulated Distribution System Laboratory Test

Another tool available for assessing the DBP formation in your distribution system is the simulated distribution system (SDS) laboratory test. In this test, samples of finished water are stored for periods of time, at a minimum, equal to the average and maximum distribution system residence times, then analyzed for TTHM and HAA5 concentrations. Appendix B describes the methodology for conducting the SDS test.

[Section to be further developed]

5.3.4 Models

A water distribution system model is a computer program that simulates the hydraulic behavior of water in a distribution system. Water distribution system models are widely used in the water industry for planning and operations. Several public domain and commercial software modeling packages are available. EPA developed a water quality modeling software package, EPANET, that is available without charge (for more information see http://www.epa.gov/ordntrnt/ORD/NRMRL/wswrd/epanet.html). Your water distribution system model should be adequately calibrated when selecting SMP sample sites (see Chapter 6 for a discussion of model calibration).

A water distribution system hydraulic model can predict water age in the distribution system when it is run under extended period simulation conditions (i.e., water production, demand, etc. are allowed to change over time). In addition, most models can track the movement of water from each plant or supply point through the distribution system. Results can provide a picture of the influence zone of each entry point and identify the blending zones and areas between zones.

The size of your system and how skeletonized your hydraulic model is determine how useful the model can be for selecting SMP sites. For example, highly skeletonized models may be of limited use in large systems where small pipes account for significant increases in system residence time. It is highly recommended that <u>existing</u>, calibrated water distribution and water quality models be used to estimate water age, identify influence zones, and identify blending areas to help select SMP sample sites. If one does not already exist, the time and expense to create a model *solely for use in selecting IDSE SMP sample sites* may not be justified. Model development or enhancement may be justified if you intend to employ the model for other uses in addition to the selection of SMP sample sites.

If you have an existing, detailed, well calibrated distribution system model, you may wish to consider completing an SSS based on the use of your model and a limited amount of new testing. Chapter 6 describes the requirements for an SSS using a water distribution system model.

1) <u>High TTHM and HAA5 Sites</u>

High residence time locations (most often your high TTHM and HAA5 sites) can be identified by estimating residence time at each node in your model. One way to represent this is by color coding the calculated residence time at each model node in the graphical view screen of the modeling software. SMP sample sites should be chosen from the area or areas of the distribution system where these high residence time model nodes are located. The SMP sample sites do not have to be chosen at the exact location of a model node, just in the general area identified by the model results. The range of residence times in the system should be assessed by reviewing the tabular report results for the model nodes and calculating the average age of water in the system.

Precautions in using model data to select high TTHM/HAA5 sites include—

- If no water demand is applied to dead-end nodes in a model, the water age results for those nodes will be meaningless

- If the model is skeletonized, the model results for high residence time areas should be compared to maps of the actual distribution system piping and to actual customer locations in those areas before sample sites are finalized

Because hydraulic models usually are somewhat skeletonized and have varying degrees of calibration and accuracy of demand allocation, best professional judgement should always be used when analyzing the results and using model outputs to assist in the selection of preliminary SMP sample sites.

2) <u>Average Residence Time Sites</u>

Average residence time sites can be selected from locations with residence times close to the average of residence times for all nodes as calculated by the model. Color coding of nodes according to residence time is an easy method of identifying areas of average residence time. Once the average is calculated from the model results, model nodes with residence times approximately equal to the system average can be color coded and displayed graphically. SMP sample sites should be chosen from the area or areas of the distribution system where these model nodes with average residence times are located.

5.3.5 Tracer Studies

Tracer studies can be used to determine actual water residence times in a distribution system under specific conditions, and are sometimes used to calibrate water distribution system models. They are particularly useful for predicting water residence time in areas of a system where there is uncertainty about true pipe diameters due to poor records or the buildup of corrosion deposits. When pipe diameters in a model are inaccurate, model predictions can be very different than the actual hydraulic conditions in a distribution system. Although tracer studies may provide very good information, they can be time consuming and costly.

You can perform a tracer study by monitoring the concentration of a conservative constituent (i.e., a chemical that does not degrade over time) through the distribution system. Chemicals used for tracers must not be harmful to people or the environment. Tracer chemicals can be substances that are—

- Specially injected or normally injected in the water for treatment purposes (e.g., hydrofluorosilic acid or sodium fluoride)
- Characteristic of the finished water (e.g., hardness, conductivity)

Before injecting any tracer, a baseline concentration of the tracer in the distribution system water should be determined (fluoride, the most common tracer, may be normally present in trace amounts). If your system adds fluoride, you can turn off the fluoride feed for a period of time, and monitor the resulting decrease of its concentration throughout the distribution system. If you do not routinely add fluoride to the finished water, you can conduct tracer tests by injecting a small dose of fluoride (about 1 mg/L) into the water entering the distribution system. However, flouride can interact with the material deposited inside pipes and storage facilities which reduces the accuracy of the calculated residence times.

To be useful in conducting the IDSE SMP, tracer studies should be conducted under conditions that represent high DBP formation (typically summer months) and provide good coverage of the entire distribution system. If the tracer study does not provide data in all areas of the distribution system, or does not provide data on the extremities of the system, it will be of limited use in selecting SMP monitoring locations. Results from previously conducted tracer studies may be used to identify areas in the distribution system with high and average residence times. However, the study should have been conducted within the past five years and represent the existing distribution system configuration.

1) <u>High TTHM and HAA5 Sites</u>

High residence time locations should be identified on a map of the system based on the tracer study field results. SMP sample sites should be chosen from the area or areas of the distribution system where these high residence time tracer study sites are located. The SMP sample sites do not have to be chosen at the exact location of the tracer study monitoring sites, just in the general area identified by the study.

2) <u>Average Residence Time</u>

The residence time at all sites sampled during the tracer test field effort should be plotted on a map of the system. The overall system average age should be calculated by averaging all the residence time results obtained during the field test. Sites with residence times approximately equal to the system average should be identified on the map and the required SMP sample sites chosen from within these areas.

5.3.6 System Operating Data

System operating data, such as pump run times, tank level data, and demand data for large industrial users may be helpful in understanding overall water flow patterns in your distribution system. For example, storage tank configuration and operation can have a significant impact on maximum and average residence times in your system. Many tanks are designed with common inlet/outlet piping and tend to "float on system pressure," meaning that they fill during periods of low demand, and discharge during periods of high demand through the same pipe. These tanks could potentially allow the fresher water the exit the tanks before the older water (especially in cases where the inlet/outlet piping is near the bottom of the tank). This will result in higher water residence time for a portion of the water that is inside the tank. Well-mixed storage tanks (i.e., tanks without "dead zones" or without significant areas where water does not circulate) with separate inlet/outlet piping typically discharge water with more consistent water residence time than do tanks with common inlet/outlet piping.

It should be noted that pump and tank operating data can be difficult to interpret, especially in more complex distribution systems, and should be viewed with caution.

5.3.7 Geographic Information System (GIS)

Geographic Information System (GIS) software is capable of assembling, storing, manipulating, and displaying geographically referenced information or data identified according to their locations. ArcView and Intergraph are examples of two packages currently available. For the drinking water industry, GIS allows large amounts of distribution system data to be compiled and users to query that data to identify areas in a distribution system meeting specified criteria. It is equivalent to plotting various data on individual see-through maps and laying those maps on top of each other so all data can be viewed together, geographically (Figure 5.3 depicts this concept).

Figure 5.3 Conceptual Diagram of GIS

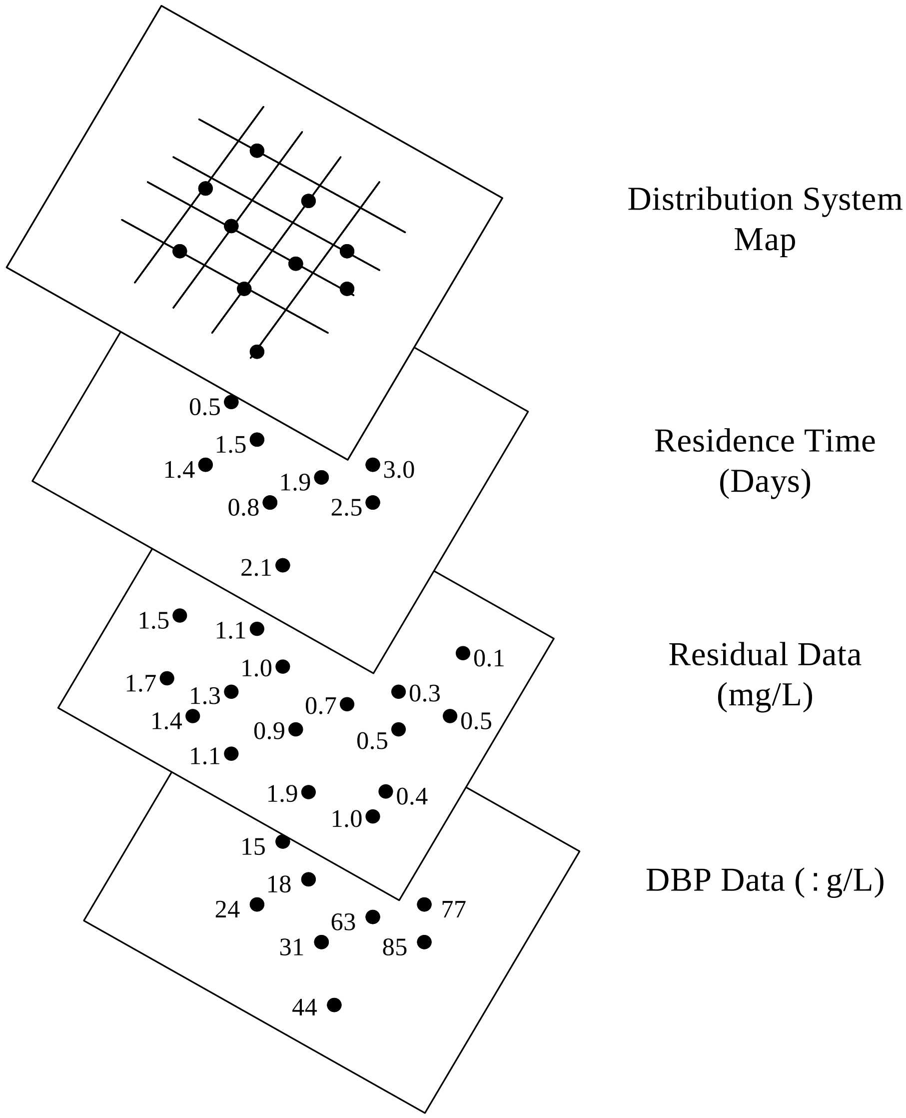


Table 5.3 summarizes the data storage capabilities of a typical GIS application.

Table 5.3 Summary of GIS Data Storage Capabilities

General System Data	Structural Data	Operational Data	Water Quality Data
Land uses and zoning Population density	Pipe diameter and length Valves and fittings Pumps Pipe age Pipe material Pipe maintenance history	Pipe velocities System pressure Pressure zones Residence time Reynolds number	Temperature Residual disinfectant Total coliforms HPC DBPs

While GIS applications can be a valuable tool for evaluating many types of distribution system data geographically, they are not hydraulic models and cannot predict system conditions. This means residence times, system pressures, pipe velocities and other operational data should be collected by some other method (e.g., hydraulic model or field measurements) and entered into the GIS database.

If data has been properly integrated into a GIS application, users can query the data to locate areas which meet several criteria for SMP sites. For example, a user may request locations where the residence time exceeds 4 days, the free chlorine residual is less than 0.25 mg/L, and the HPC count is less than 500. Most GIS applications can highlight those locations on a map of the distribution system. The user can then select geographically diverse locations from these areas for the purposes of IDSE SMP monitoring.

The procedure by which GIS identifies preliminary SMP sample locations is similar to the process an individual might use if they were doing the analysis by hand. However, GIS is capable of looking at a larger amount of data in an integrated manner, without the excess time of plotting the data by hand. Purchasing a GIS application solely for the purpose of conducting the IDSE may not be efficient because there will be a considerable effort involved in getting the system up and running. However, if your system currently utilizes or is planning to purchase a GIS application, consideration should be given to using the application as a tool for identifying SMP sites.

5.4 Using Multiple Data Sources and Tools to Select Final SMP Sites

As described in the previous section, various data sources and tools can be used to identify SMP sites, but some may provide more accurate estimates of high TTHM and HAA5 locations or average residence time locations than others. How do you prioritize the data and combine data sources and tools to select final SMP sites? This section addresses these questions by providing general guidelines for (1) identifying all possible preliminary SMP sites and (2) narrowing down the preliminary sites to final SMP sites. Detailed guidance for identifying preliminary sites using each data source or tool is provided in the previous section– this section focuses on combining tools to select preliminary and final sites.

A key to selecting final SMP sites is the ability to plot preliminary sites on a detailed map of your distribution system. You should always visually confirm that SMP sites are in expected areas of high and average residence time and that you are not missing key areas that have not traditionally been sampled. Additional spreadsheet evaluation can be helpful. If you have GIS capabilities, queries can be extremely useful in automating the site selection process. In particular, GIS queries can be used to evaluate multiple data sources for you rather than having you perform the time consuming process of evaluating multiple parameters by hand or in a spreadsheet.

The information and considerations presented in this section are not intended to be limiting or prescriptive. EPA recognizes DBP formation is system-specific and the guidance provided in this manual will not apply to every system. The operational experience and knowledge of system personnel and all available information should be considered in selecting SMP sample sites. Best professional judgement should be exercised in the specific application of guidelines in this manual.

5.4.1 Selecting Preliminary Sites Using Combinations of Tools and Data Sources

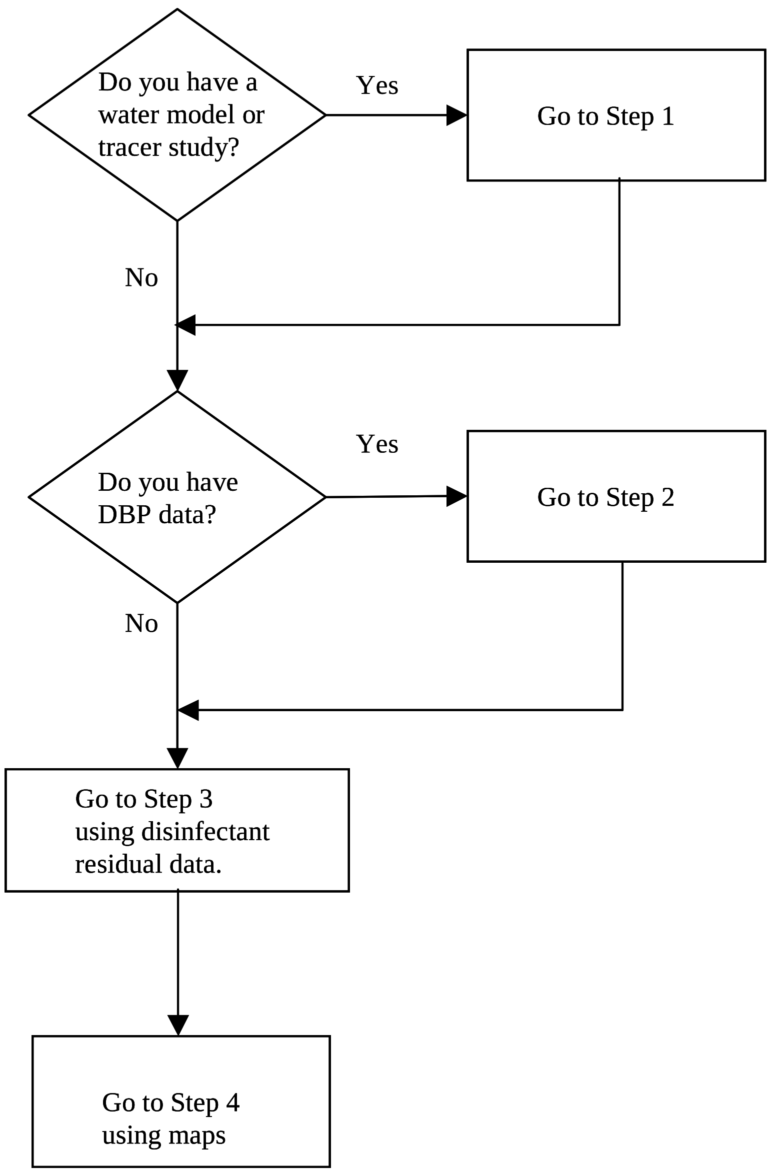
This section contains a multi-step process that allows you to use any combination of the following data sources to select preliminary sites—

- Water distribution system model outputs
- Tracer study results
- DBP data
- Disinfectant residual data

Figure 5.4 is flow-chart that indicates at which step you should start, depending on your available data sources. All steps involve plotting preliminary sites on a map of your distribution system.

The steps in this section focus on selecting preliminary high TTHM and HAA5 sites at locations of high residence time. Guidance for selecting average residence time sites is specific to subpart H systems serving 10,000 or more people and is presented separately at the end of each step in this section.

Figure 5.4 Flow Chart for Identifying Preliminary Sites



<u>Step 1:</u> Use output from your water distribution system model or tracer study results to identify areas with the highest residence times (representing potential locations for high TTHM and HAA5 SMP sites). You should identify at least **twice** as many TTHM and HAA5 SMP sites as required.

- For example, subpart H systems serving 500 to 9,999 people must have at least one high TTHM and one high HAA5 site for the SMP; therefore, they should select at least two preliminary high TTHM sites and two preliminary high HAA5 sites using model or tracer study data.

- *Subpart H systems serving 10,000 or more people*: use output from your water distribution system model or tracer study results to identify areas with the average residence times. Identify at least **four** preliminary sites.

Plot all preliminary sites on a map of your distribution system.

<u>Step 2</u>: Review DBP data and identify areas with highest DBP concentrations. Plot these areas on your distribution system map.

If you completed Step 1:

Determine if the high DBP locations correspond to areas with high water residence time. It is possible that the water distribution system model or tracer study did not capture mixing effects or other factors leading to higher residence times than predicted. If the DBP data occurs outside predicted areas of high residence time, you should select additional preliminary sites to cover these areas.

<u>Step 3</u>: Review disinfectant residual data from warmer months and identify areas with lowest or no disinfectant residuals. Plot these areas on your distribution system map.

If you did <u>not</u> complete step 1:

Evaluate your disinfectant residual data and identify areas with the lowest or no residual concentrations (representing potential locations for high TTHM and HAA5 SMP sites) Identify at least **twice** as many SMP sites as required.

If you completed step 1:

Determine if the low residual areas correspond to areas with high residence times. As noted in Step 2, it is possible that the water distribution system model or tracer study did not capture mixing effects or other factors leading to higher residence times than predicted. However, disinfectant residual data should be viewed with caution because there are cases where lower disinfectant residual does not necessarily indicate higher water residence time due to internal corrosion, biological activity, etc. (refer to section 5.3.2.1 for a more complete description of other factors affecting disinfectant residual decay). If low chlorine residual results are seen outside predicted areas of high residence time, you may wish to select additional preliminary sites to cover these areas.

Subpart H systems serving 10,000 or more people:

Review disinfectant residual data compared to the average residence time site identified by your water distribution system model or tracer study (see Section 5.3.2.1 for guidance on identifying areas of average residence time using disinfectant residual data). Identify additional preliminary SMP sites for average residence times if your residual data show different locations than results from your model or tracer study.

Step 4: Review your water distribution system map to identify additional SMP locations not identified in Steps 1 through 3 where—

- There is light development or low residential population furthest away from a treatment plant.
- An area is served by one or more distribution system storage facilities, especially if the storage facility(s) have high water residence times.
- An area is served by booster disinfection stations.

Generally, you should *not* select preliminary sites at the very end of a water main past the last customer. At the last group of customers would be a better location.

5.4.2 Narrowing Down Preliminary Sites to Final SMP Sites

Below are general guidelines for narrowing down your preliminary sites identified in Section 5.4.1 to final SMP sites. EPA recognizes there are system-specific factors that may lead you to select final sites that don't specifically meet these guidelines. If you do not follow the guidelines, provide justification to your State in your IDSE Report.

Selecting High TTHM and HAA5 Sites (All Systems)

1) Prioritize sites that meet criteria for more than one data source (e.g., locations that have low disinfectant residual and are in remote areas of your system)

2) Select sites in hydraulically different areas (i.e., do not select two sites close to one another).

3) Do not select SMP sites that are close to existing Stage 1 DBPR sites.

4) Select high TTHM sites generally after storage facilities and always after booster disinfection stations.

5) High TTHM sites should be in areas with the lowest or no residual disinfectant (unless your system uses booster disinfection).

6) High HAA5 sites should have a minimum of 0.2 mg/L chlorine residual or 0.5 mg/L chloramine residual for all observations.

7) Locate at least one of your high TTHM sites in a remote area of your distribution system. If you are only required to select one high TTHM site, it is strongly recommended that you locate this site far away from the treatment plant, at the last customer on a dead-end main.

8) DBP data are very important as long as they represent your current system configuration – if you have high TTHM or HAA5 data in an area, these data should override other factors.

Specific Guidance for Systems Serving Less than 500 People

9) Select your high TTHM site in a high residence time area that is not near your Stage 1 DBPR site. (Your Stage 1 DBPR site must be located at your maximum residence location. If you must conduct an IDSE then your Stage 1 site is most likely not capturing both your high TTHM and high HAA5 concentrations—you need to test a different area of the distribution system that is likely to have high residence time).

Also consider selecting a different type of area that could have high residence times. For example, if your Stage 1 site is at the end of a line in a relatively remote area, select a site that is on the other side of the distribution system.

10) Select your high HAA5 site reflecting a different location than the high TTHM and Stage 1 sites. If those two sites cover the high residence time areas of your distribution system, then select a site in an area with average residence time (see Section 5.3.2.1 for determining average residence time based on disinfectant residual data) for your high HAA5. The highest HAA5 concentrations often do not occur at the highest residence time locations. There may be system-specific factors that cause HAA5 to biodegrade and therefore areas with average residence time may have the highest HAA5 concentrations.

Selecting Average Residence Time Sites (specifically for subpart H systems serving 10,000 or more people)

11) From the preliminary average residence time sites identified in steps 1 and 3, select final average residence time sites that are geographically diverse with the other SMP sites.

5.5 Using SMP Results to Select Stage 2B Compliance Monitoring Sites

Table 5.4 compares the Stage 1 DBPR and Stage 2B DBPR compliance monitoring requirements according to source water type and system size. This section explains how IDSE SMP monitoring results and Stage 1 DBPR monitoring data can be used to select Stage 2B Compliance monitoring sites. Section 5.5.1 provides guidance to Subpart H systems serving 10,000 or more people, and Section 5.5.2 provides guidance for all other system sizes and source water types.

Table 5.4 Comparison of Stage 1 and Stage 2B DBPR Monitoring Requirements

System Description[1]	Stage 1 DBPR	Stage 2B DBPR
Subpart H systems (≥ 10,000)	• 4 sites per plant • **25 percent (1 per plant) at maximum residence time** • Samples collected quarterly	• **4 sites per plant (dual samples)[2]** – **1 representative of average residence time from Stage 1 DBPR sites** – **1 representative of high HAA5** – **2 representative of high TTHM** • Samples collected quarterly
Subpart H systems (500 - 9,999)	• **1 site per plant** • **At maximum residence time** • Samples collected quarterly	• **2 sites per plant (dual samples)[2]** – **1 representative of high HAA5** – **1 representative of high TTHM** **If State determines these are at the same location, monitor only at 1 site.* • Samples collected quarterly
Subpart H systems (< 500)	• **1 site per plant** • **At maximum residence time** • Samples collected annually – If annual result exceed MCL then must sample quarterly	• **2 sites per plant (single samples)[2]** – **1 representative of high HAA5** – **1 representative of high TTHM** ***If State determines these are at the same location, monitor only at 1 site.* • Samples collected annually – If annual result exceeds MCL, then must sample quarterly
Ground water systems (≥ 10,000)	• **1 site per plant** • **At maximum residence time** • Samples collected quarterly	• **2 sites per plant (dual samples)[2]** – **1 representative of high HAA5** – **1 representative of high TTHM** **If State determines these are at the same location, monitor only at 1 site. If these do not occur at the same location, the system may collect single samples at 2 sites.* • Samples collected quarterly
Ground water systems (500 - 9,999)	• **1 site per plant** • **At maximum residence time** • Sample collected annually – If annual result exceed MCL then must sample quarterly	• **2 sites per plant (dual samples)[2]** – **1 representative of high HAA5** – **1 representative of high TTHM** **If State determines these are at the same location, monitor only at 1 site.* • Samples collected annually - If annual result exceeds MCL then must sample quarterly
Ground water systems (< 500)	• **1 site per plant** • **At maximum residence time** • Sample collected annually – If annual result exceed MCL then must sample quarterly	• **2 sites per plant (single samples)[2]** – **1 representative of high HAA5** – **1 representative of high TTHM** **If State determines these are at the same location, monitor only at 1 site. If these do not occur at the same location, the system may collect single samples at 2 sites.* • Samples collected annually - If annual result exceeds MCL then must sample quarterly

[1] Requirements apply to CWSs and NTNCWSs
[2] "Dual samples" means two samples are collected at the same time and one is analyzed for TTHM and the second for HAA5

5.5.1 Guidance for Subpart H Systems Serving 10,000 or more People

For surface water systems serving 10,000 or more people, the Stage 2B DBPR requires monitoring at four sample sites per plant—

- Two sites representative of the highest TTHM concentrations identified during the SMP period.

- One site representative of the highest HAA5 concentration identified during the SMP period.

- One site representative of average residence time selected from the three Stage 1 DBPR average residence time compliance monitoring sites (the site with either the highest TTHM or HAA5 concentration).

> Choose your Stage 2B sites from your SMP and Stage 1 sites

The two sites representative of the highest TTHM and the one site representative of highest HAA5 concentration may be chosen from the SMP sites or your existing Stage 1 DBPR compliance monitoring sites. The choice of all Stage 2B DBPR compliance monitoring sites should be based primarily on the highest locational running annual averages (LRAAs) of TTHM and HAA5 results calculated for each of the SMP and Stage 1 sites. However, the benefits of maintaining a good geographic and hydraulic coverage of your distribution system should also be taken into consideration.

Specific guidance for selecting the Stage 2B DBPR sites follow. Requirements and recommendations for your IDSE SMP report are provided in Section 5.6.

Selecting the High TTHM and HAA5 Sites from SMP and Stage 1 DBPR sites—

The following methodology details how Stage 2B DBPR compliance sites are selected and reported.

1) Calculate a TTHM and HAA5 LRAA at each SMP site.

2) Calculate a TTHM and HAA5 LRAA at each Stage 1 DBPR compliance monitoring site using data from the same time period that the SMP occurred.

3) Compare results from both SMP and Stage 1DBRPR and select your Stage 2B sites based on the highest LRAAs.

In general, the two representative highest TTHM sites (per plant) should not be from the same area of your distribution system. Consider the following example—

- If the two highest TTHM LRAAs in your distribution system are from adjacent SMP sample sites (sites A and B), and if the site with the third highest TTHM LRAA is on the far side of your distribution system (site C), consider selecting sites **A and C** or **B and C** as your Stage 2 sites. This selection would provide a broader geographical coverage of your distribution system.

If the LRAA of the Stage 1 DBPR maximum residence time compliance monitoring site is higher or equal to the LRAA of the SMP sites, you may want to consider retaining your Stage 1 DBPR maximum residence time site as a high TTHM or HAA5 site for the Stage 2B DBPR. Retaining an existing Stage 1 DBPR site would allow you to directly compare results of future monitoring to historical data at a consistent location in your distribution system. However, if the LRAA at your existing Stage 1 maximum residence time sample site is less than the highest LRAAs of your SMP sample sites, your Stage 2 DBPR compliance sites should be chosen from your SMP sample sites. If significant treatment changes have been made to the system, then there may be less benefit in maintaining historical sites.

If an unexpected change occurred which makes future sampling at an SMP site impractical or impossible, then a location near the SMP site can be chosen for Stage 2 DBPR compliance monitoring.

Selecting Your SMP Site from Stage 1 DBPR Sites of Average Residence Time

One of the four Stage 2B DBPR sites (per plant) must be selected from among your three existing Stage 1 DBPR compliance sites that represent average residence time. You should select the average Stage 1 DBPR site with the highest TTHM and HAA5 LRAAs. If the highest TTHM and HAA5 LRAAs do not occur at the same site, you should select the site with the highest TTHM LRAA.

5.5.2 Guidance for Subpart H Systems Serving Fewer Than 10,000 People and All Ground Water Systems

For Subpart H systems serving fewer than 10,000 people and all ground water systems, the Stage 2 DBPR requires monitoring at two sample sites per plant* (See Table 5.4 for frequency of sampling based on source water type and system size)—

- One site representative of the highest TTHM concentrations identified during the SMP period.

- One site representative of the highest HAA5 concentration identified during the SMP period.

*After approval by the State, systems with a single location that has the highest TTHM LRAA and highest HAA5 LRAA may take dual samples only at that location.

> Choose your high TTHM and HAA5 Stage 2B sites from your SMP and Stage 1 sites

These sites may be chosen from the SMP sites or your existing Stage 1 DBPR sites and should be based primarily on the highest locational running annual average (LRAA) of TTHM and HAA5 results at each site. The benefits of maintaining a good geographic coverage of your distribution system should also be taken into consideration when selecting between high sites.

Specific guidance for selecting the Stage 2 DBPR sites follow. Requirements and recommendations for your IDSE SMP report are provided in Section 5.6.

The following methodology details how Stage 2 DBPR compliance sites are selected and reported.

1) Calculate a TTHM and HAA5 LRAA at each SMP site.

2) Calculate a TTHM and HAA5 LRAA at each Stage 1 DBPR site using data from the same time period that the SMP occurred.

3) Compare results and select your Stage 2 DBPR sites with the highest LRAAs for—

    - One TTHM
    - One HAA5

In general, the two sites (per plant) should not be from the same area of your distribution system. Consider the following example—

- If the two highest TTHM LRAAs in your distribution system are from adjacent SMP sample sites (sites A and B), and if the site with the third highest TTHM LRAA is a Stage 1 site on the far side of your distribution system (site C), consider selecting sites **A and C** or **B and C** as your Stage 2 sites. This selection would provide a broader geographical coverage of your distribution system.

5.6 Minimum Requirements For an IDSE Report

The primary purpose of the IDSE report is to propose Stage 2B DBPR compliance sampling sites and justify that they meet the Stage 2B requirements. As stated in Chapter 1, your IDSE SMP report must contain the following—

- Original SMP monitoring plan and an explanation of any deviations from that plan
- All SMP TTHM and HAA5 analytical results
- All TTHM and HAA5 analytical results from Stage 1 DBPR compliance monitoring collected during the period of the IDSE
- A schematic of your distribution system with results, location, and date of all IDSE SMP and compliance samples noted
- Recommendations for locating Stage 2B compliance monitoring sites
- Justification for selection of Stage 2B compliance monitoring sites

Your IDSE report should also provide justification for the selection of IDSE SMP sites. Refer to Appendices C-H for example IDSE reports based on source water and system size (see Table 5.5).

Table 5.5 Example IDSE Reports

	Example Type	**System Characteristics**
Appendix C	IDSE SMP Report	Subpart H ($\geq$ 10,000)
Appendix D	IDSE SMP Report	Ground water ($\geq$ 10,000)
Appendix E	IDSE SMP Report	Subpart H (500 - 9,999)
Appendix F	IDSE SMP Report	Ground water (< 10,000)
Appendix G	IDSE SSS Report	Subpart H ($\geq$ 10,000)
Appendix H	Stage 2B DBPR Site Selection Report	Systems not Performing an IDSE SMP or SSS

6.0 System-Specific Studies

6.1 Introduction

Instead of conducting a Standard Monitoring Program (SMP) as described in previous chapters, you may complete a System-Specific Study (SSS) using historical data, distribution system models, or other analyses to meet the IDSE requirements of the Stage 2 DBPR. This chapter discusses the use of an SSS in place of an SMP. The remainder of this chapter is organized as follows—

- 6.2 Summary of IDSE Requirements for Completing an SSS
- 6.3 Appropriate SSSs
- 6.4 Using Historical Data for Your SSS
- 6.5 Using a Water Distribution System Model for Your SSS
- 6.6 Minimum Requirements for an IDSE SSS Report

6.2 Summary of IDSE Requirements for Completing an SSS

The Stage 2B DBPR requires that an SSS provide *equivalent or superior selection* of new Stage 2B DBPR compliance monitoring sites that target high DBP levels as compared to the selection of sites resulting from an SMP. The main purpose of the SSS is to allow systems with extensive data, previous pertinent studies, or detailed knowledge of their operations to use these resources in choosing new monitoring sites and thus avoid the expense of the SMP. The development of *new* detailed and expensive studies is not intended or required.

> Your SSS must provide **equivalent** or **superior** selection of Stage 2B DBPR sites compared to selection of sites resulting from an SMP.

All systems serving 10,000 or more people (as well as consecutive systems on the same schedule as those systems[1]) will have to make decisions whether or not to forego the SMP in favor of an SSS *before* States are expected to receive primacy for the Stage 2 DBPR. This means that States generally will be unable to formally approve or accept the use of an SSS prior to the required start date of the SMP. If a system decides not to conduct the SMP and completes an SSS that is ultimately not approved by the State, that system will be in violation of the IDSE monitoring requirements. To avoid the potential of a violation, systems are encouraged to complete an IDSE SMP if there is any doubt about the acceptability of their SSS.

[1]Consecutive systems must submit their IDSE report at the compliance date of the largest system in the combined distribution system.

6.3 Appropriate SSSs

You may use historical monitoring data, new monitoring data, water distribution modeling, tracer study results, and other distribution system analyses as part of your SSS to justify the selection of Stage 2B DBPR compliance monitoring sites. EPA has identified two "pre-defined" SSSs that are expected to provide equivalent or superior selection of compliance sites as compared to the SMP—

- **The use of historical DBP data that equals or exceeds the IDSE monitoring requirements.**

- **The use of a calibrated water distribution system hydraulic model and one round of new sampling during the month of peak DBP levels (or water temperature if DBP data is not available).**

Sections 6.4 and 6.5 present the requirements for the SSS using historical data and hydraulic distribution system models, respectively. Failure to meet any of these criteria may result in your SSS being rejected by your State. These sections also provide guidelines for States who will evaluate the adequacy of an SSS.

EPA recognizes that there are other combinations of data and system analyses that may provide equivalent or superior selection of Stage 2B compliance monitoring sites. Potential combinations include, but are not limited to—

- A combination of historical and new TTHM and HAA5 data.

    – To be considered valid, all historical data should meet requirements of section 6.4.
    – The total number of samples analyzed should be equal to or greater than the total number of samples required for the IDSE SMP.

        < For example, if you are a large surface water system with chlorine residual disinfection, you should have (1) at least 8 sample sites per treatment plant, with at least 5 representing preliminary high TTHM/HAA5 locations, and (2) at least 6 TTHM and HAA5 samples from each site (equivalent to requirements for SMP monitoring), with at least one round of samples collected during the month of highest DBP levels or water temperature.

- Historical or new TTHM and HAA5 data that is fewer than data that would be collected under the IDSE SMP, combined with an analysis of a distribution system time-of-travel tracer study.

    – In general, the tracer study should have been conducted in the last five years and reflect the existing distribution system configuration.
    – The tracer study should represent conditions of high DBP formation potential (typically summer months).
    – The tracer study should be detailed enough to provide good characterization of water residence time for the entire distribution system.

- Generally, tracer studies can be good indicators of sites with average water residence times.
- If the tracer study does not provide residence time information for the extremities of the distribution system, systems should have historical or new data at representative high TTHM and HAA5 locations.
- Regardless of the level of detail of the tracer study, systems should have at least one round of sampling data at the required SMP sites during the month of highest DBP levels or water temperature.

The distribution system data and analyses listed above are not definitive — alternative SSSs will be evaluated on a case-by-case basis by the State. In general, any alternative SSS should be representative of your full distribution system and provide equivalent or superior selection of Stage 2B DBPR monitoring sites compared to the IDSE SMP. If you are uncertain whether your historical data, water distribution system model, or other study meets the requirements of the SSS, you may wish to consider the SMP alternative. At minimum, you should supplement any SSS with at least one round of sampling during your historic high DBP or temperature month at the number of locations as dictated by your SMP requirements (See Table 1.1 for a summary of SMP requirements).

6.4 Using Historical Data for Your SSS

If you've already performed supplemental DBP monitoring in your distribution system and no major treatment changes have occurred in your system since the data was collected, you may wish to evaluate your historical TTHM and HAA5 data to determine if it can be used for the IDSE SSS. Section 6.4.1 provides the minimum requirements for using historical data. Section 6.4.2 explains how to use your historical data to select Stage 2B DBPR monitoring sites.

6.4.1 Minimum Data Requirements

If you decide to use *only* historical TTHM and HAA5 data to select Stage 2B DBPR compliance monitoring sites, the data must be equivalent or superior to the data that would be collected under the SMP. This section describes the minimum requirements for using historical data as one of the two pre-defined SSSs presented in this guidance manual. If your historical data set *does not* meet these requirements, you may be able to use it in combination with other analyses for your SSS. Refer to Section 6.3 for guidelines on evaluating alterative SSSs.

6.4.1.1 Sample Location and Frequency

Historical data should be representative of your full distribution system. At a minimum they should meet the overall SMP requirements with respect to—

- Number of sites
- Locations of sites
- Number of samples per site
- Sample collection timing throughout the year

- Sampling during peak historical month (for distribution system water temperature or DBPs)

Table 1.1 summarizes the SMP sample site requirements for various systems sizes, source waters, and residual disinfectant types (see Chapter 2, 3, or 4 for more details). Use of historical sites that are equivalent to each of the required SMP sites should be specifically identified (e.g., entry point, average residence time, highest TTHM concentration). Using data from historical sites in excess of the required number of SMP sites is acceptable and encouraged.

The SMP requires that dual samples for TTHM and HAA5 be collected from each site. The frequency of sampling is dependent upon the size of the system, but an SMP sample set should be collected during the month with the maximum temperature and/or highest recorded TTHM concentration. Note that specific sampling requirements of the SMP do not have to be mirrored precisely in your historical data set, but the overall intent of the SMP should be satisfied. For example—

- If more sites per plant were sampled than is required by the SMP, fewer sample periods may be acceptable.

- A system that collected samples quarterly (rather than bimonthly) for multiple years at an appropriate number of locations, would have acceptable data for an SSS.

Samples should have been collected during the <u>peak temperature or peak DBP month</u> and at representative times throughout the year, equivalent to the monitoring frequency of the Stage 1 DBPR, at a minimum.

6.4.1.2 Analytical Data Quality

Historical TTHM and HAA5 samples should have been analyzed by a laboratory certified under the Drinking Water Certification Program to perform these measurements and using approved methods. Contact your laboratory or your State to confirm certification status.

6.4.1.3 Historical Sampling Period

Only data collected within the five years preceding the due date of the IDSE report should be used for your SSS. Also, *at least* 50 percent of the historical samples should have been collected in the three years prior to your system's IDSE report due date. Figures 6.1 and 6.2 depict acceptable historical sampling periods for systems of different sizes and source water types.

Figure 6.1 SSS Historical Sampling Period for Systems Serving ≥10,000 People

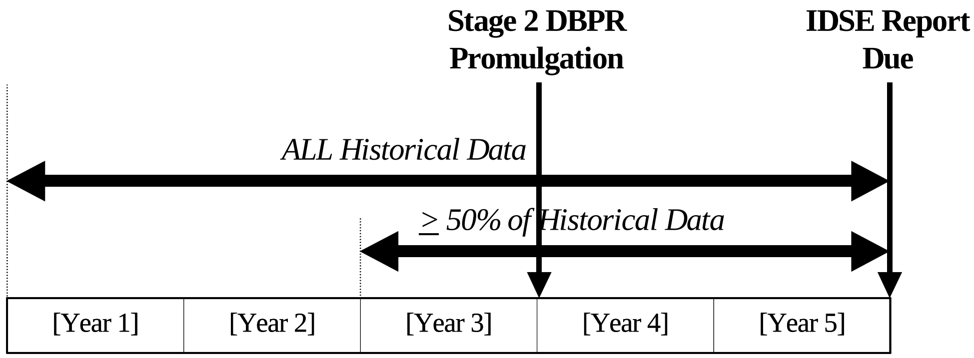
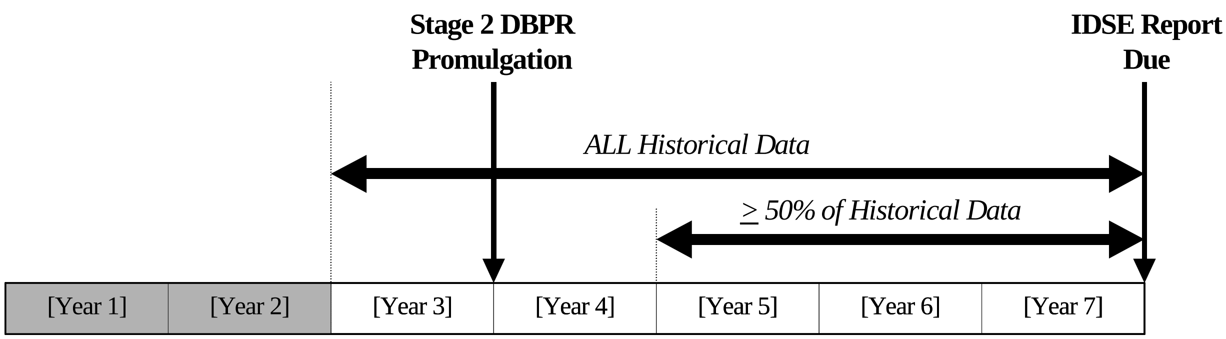


Figure 6.2 SSS Historical Sampling Period for Systems Serving < 10,000 People



[Actual time line to be provided]

6.4.1.4 Treatment and Source Conditions

Historical data should reflect the source water(s) and treatment configuration in place at the time that your IDSE report is due (see Figures 6.1 and 6.2 for IDSE report schedules). Regular maintenance, rehabilitation, and upgrades of plant processes within your historical sampling period is acceptable. If your system made changes that significantly affected DBP formation and/or plant production rates, only historical data from *after* the change should be used for your SSS.

Significant process changes that should be considered as "cutoff points" for use of historical data include—

- Modification to disinfection practices— the historical period should represent current primary and secondary disinfection practices.

  – Changing a disinfectant for primary disinfection

- Switching to chloramines for secondary disinfection
- Changing the point of disinfection application in the treatment plant
- Adding booster chlorination in the distribution system

• Major changes in plant production rates that change the influence zone of a treatment plant.

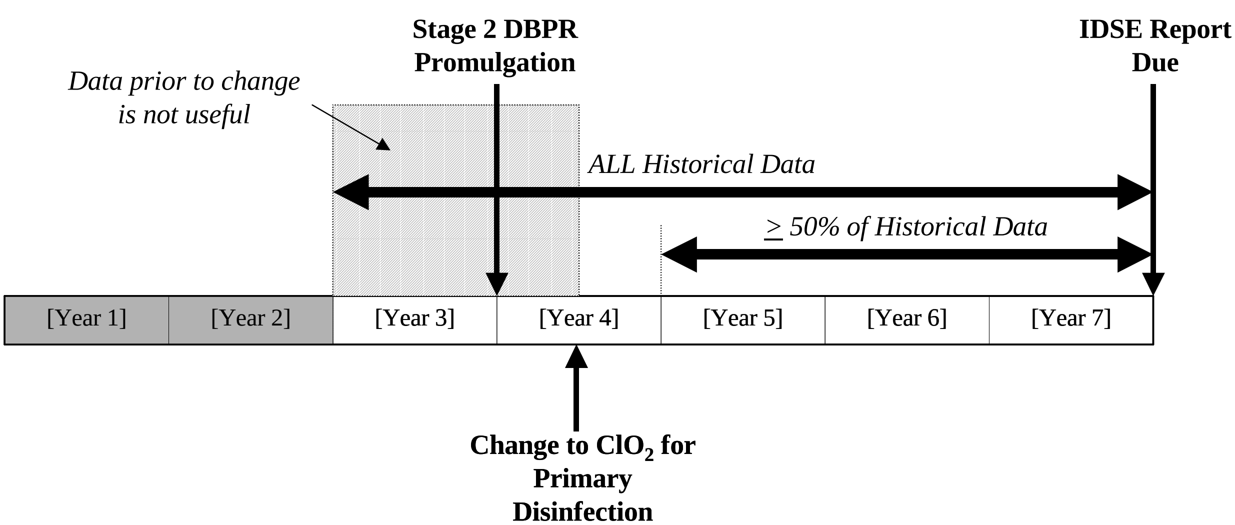
• Major changes in water use patterns that include—

- Addition or removal of a high water use industrial customer
- Replacement of mains that significantly change system hydraulics

• Major changes in raw water sources that affected DBP concentrations in water produced by the plant (e.g., addition of a new water source).

Figure 6.3 provides an example of a surface water plant serving fewer than 10,000 people that changed to chlorine dioxide disinfection during the historical sampling period.

Figure 6.3 Example of Historical Data Limitations for Systems Serving < 10,000 People



6.4.1.5 Distribution System Conditions

The historical data set should also reflect the overall distribution system hydraulic operation and large scale movement of water through the system at the time your IDSE report is due (see Figures 6.1 and 6.2 for IDSE report schedules). Normal seasonal changes in system operation during your historical sampling period is acceptable. Supply points, pressure zones, large transmission mains, pump stations, storage tanks, and large wholesale and retail customers should be consistent throughout your historical sampling period.

6.4.2 Selecting Stage 2B DBPR Monitoring Sites

Table 5.4 provides a comparison of the Stage 1 and 2B DBPR monitoring site requirements for systems of different sizes and water sources.

The following steps show how Stage 2B DBPR sites can be selected from historical data—

1) Calculate the annual average TTHM and HAA5 concentrations for each site for which you have historical data covering at least one full year.

   - If your data covers a longer period, calculate annual averages for each full year and select the highest average (see example in Appendix G sample calculations).

2) Calculate the annual average TTHM and HAA5 concentrations at each Stage 1 DBPR compliance site (if not included in the historical data set) for as much of the historical time period as possible.

3) Determine the highest TTHM and HAA5 annual averages from the Stage 1 compliance monitoring and historical data (see Table 1.1 for how many high TTHM and HAA5 sites are required for your system type).

Usually, the sites with the highest locational running annual averages should become your Stage 2B compliance sites; however, there are other factors that may make another site with a slightly lower annual average a better choice. Use best professional judgement in evaluating all factors and include your justification in the IDSE report.

- For example, say “site A” has a maximum annual average TTHM concentration of 64 µg/L, and “site B” has a maximum of 66 µg/L. If you have historical data covering a longer time period for site A, you may want select site A instead of B as your representative highest TTHM site because of the added value of maintaining a historical database for a given location.

Flexibility in selecting sites allows systems to observe long-term trends in historical DBP concentrations at one location and relate them to treatment and distribution operations.

6.5 Using a Water Distribution System Model for your SSS

The second pre-defined SSS addressed in this guidance manual involves the use of a detailed, comprehensive, and well-calibrated hydraulic water distribution system model to select Stage 2B DBPR compliance monitoring sites. Hydraulic models are used to simulate water movement in a distribution system, and can, when properly calibrated, be used to estimate residence time, system demand patterns, and pressure zones. Hydraulic models *do not* estimate water quality parameters such as disinfectant residual or DBP concentrations. There are more robust *water quality* models available that can reasonably estimate disinfectant residuals, and in some cases

DBP concentrations, in addition to hydraulic patterns. If you have a well-calibrated water quality model it may provide superior Stage 2B site selection; however, this section *does not* include a discussion of such models.

To meet requirements of the pre-defined SSS, operation of a water distribution system should be simulated over extended periods under the different seasonal, demand, and operating conditions that are typical for a particular system. The results should then be used to determine—

- The spatial and temporal patterns of water movement from all sources (if there are multiple sources of supply)

- The typical pattern of residence time in the system

Model results should be combined with a single round of TTHM and HAA5 sampling in the historic warmest or highest DBP month to select appropriate compliance sites.

This section presents minimum requirements for water distribution system models to be used as the primary component of an SSS for selecting Stage 2B compliance sites. Alternative SSSs may involve the use of a less robust model, supplemented with data from tracer studies or historical monitoring.

The option of using a water distribution system model is intended to allow systems with models to use their *existing* technical resources to help select Stage 2B DBPR compliance monitoring sites. For many systems, developing a detailed, well calibrated water distribution system model from scratch will cost more than conducting an IDSE SMP. If the model will be used for other purposes after the completion of the SSS, such as optimizing system operations and prioritizing capital improvements, then the cost of the model development may be justified.

6.5.1 Minimum Model Requirements

In general, your water distribution system model should be more comprehensive for the purpose of an SSS than models typically used for long-range capital improvement program analysis. This section describes the requirements for the second pre-defined SSS: using water distribution system models as the primary tool for selecting Stage 2B DBPR sites. If your model *does not* meet the requirements in this section, you may be able to upgrade the model or use it in combination with other data and/or analyses for your SSS.

6.5.1.1 Model Details

Most water distribution system models do not include every pipe in a distribution system. Typically, small pipes near the periphery of the system and other pipes that affect relatively few customers are excluded. This process is called skeletonization.

It is a generally accepted practice to skeletonize models to a certain extent depending on the model's intended use. To be used for the selection of Stage 2B DBPR monitoring sites, your model should be relatively detailed and include the majority of pipes. Specifically, EPA recommends that your model include—

- At least 50 percent of total pipe length in the distribution system
- At least 80 percent of the pipe volume in the distribution system
- All 12-inch diameter and larger pipes
- All 8-inch and larger pipes that connect zones, storage facilities, major demand areas, pumps, and control valves, or are significant conveyors of water
- All 6-inch and larger pipes that connect remote areas of a distribution system to the main portion of the system
- All storage facilities with realistic controls applied to govern the open/close status of the facility
- All active pump stations with realistic controls applied to govern their on/off status

6.5.1.2 Accurate Simulation of Water Consumption

Water consumption (demands) should be accurately simulated in the model—

- Water demand data should be assigned to at least half of the nodes in the model

- Water demand should generally be assigned to all end nodes so that the flow of water is simulated in dead-end pipes and remote areas of your system.

- Demand data should reflect, at a minimum—

  - domestic water use
  - large industrial users
  - unaccounted for system water losses
  - seasonal trends

- A system-specific, diurnal (24-hour) demand pattern should be applied to the overall system demand. Your demand pattern can be derived from a review of master meter flows, tank levels, pumping rates, or other similar operational data.

6.5.1.3 Model Calibration

Generally, calibration is the process of—

- Compiling field data on pressures and flows in the systems under known conditions
- Comparing model results with field data
- Adjusting the model (e.g., pipe roughness factors, tank/pump operational settings, etc.) to agree with field data

Calibration is never exact, and there are no official calibration standards or guidelines in the United States. There is general agreement in the modeling profession that the extent of calibration should reflect the intended uses of the model. For example, a greater degree of model calibration is expected when the model is used for design work rather than for master planning. An intermediate level of calibration is acceptable in a model used to guide the selection of compliance monitoring sites. For more information regarding the calibration of distribution system models, please consult AWWA Manual M-32, Distribution Network Analysis.

It is recommended that you verify the reasonableness of your model calibration by comparing residence time estimates with disinfectant residual data. To do this, plot (electronically or by hand) the residence time estimates obtained from your model and disinfectant residual monitoring results on a map of the distribution system. Disinfectant residuals should be similar for locations with equivalent residence times (disregarding pipe tuberculation, biofilm, etc.). If disinfectant residuals are *not* similar in areas with similar residuals, it is possible your calibration is insufficient. If you encounter this situation, but believe your model calibration is accurate, you should provide a justification for this inconsistency in data.

6.5.2 Selecting Stage 2B DBPR Compliance Monitoring Sites Using Model Results

To select Stage 2B compliance monitoring sites using your water distribution system model, you should—

- Run the model in extended period simulation (EPS) mode to determine residence time, influence zones, and mixing zones in your distribution system
- Choose preliminary Stage 2B sites satisfying the SMP sample site requirements based on model results
- Conduct one round of sampling at those sites during the month of highest DBP levels or water temperature in your system
- Use combined model and monitoring results to select your Stage 2B compliance monitoring sites

The following sections provide detailed guidance for each step above.

6.5.2.1 Running the Model to Estimate Residence Time, Influence Zones, and Mixing Zones

Modeling can be performed in either steady-state or extended period simulation mode. In steady-state mode, all variables remain constant over time (demands, tank water levels, etc.). In EPS mode variables are allowed to change over time. Since residence time is affected by the daily cycle of water use and operation, EPS modeling should be used to select preliminary Stage 2B DBPR compliance monitoring sites. EPS models should be run until a consistent pattern of residence time is established at all nodes of the model. Depending on particular system characteristics and the specific starting conditions imposed on the model, this may require from 7 to 21 days or more of EPS time. An EPS model usually needs to be run much longer than the actual maximum residence time of water in a particular distribution system before a consistent pattern of residence time is attained.

The model should be run under conditions of high DBP formation potential. In most areas of the United States, water demand and system operation vary seasonally. Seasonal variations can generally be classified into summer conditions (high usage), winter conditions (low usage), spring-autumn conditions (medium usage), or wet and dry period conditions. In applying a model to select preliminary Stage 2B monitoring sites, the examination of summer usage will generally suffice if summer conditions represent the highest DBP formation potential (see Appendix A for information on DBP formation).

Source tracing should be used to determine zones of influence and mixing zones in systems with multiple plants. Most models have a “source tracing” option in which the percentage of water coming from a single source can be traced over the course of several days. By tracing each source separately, a map can be generated showing areas always (or predominantly) receiving water from a single source and mixing zones where, either on a diurnal or a seasonal basis, water is received from multiple sources. This information is used to make informed selections of sampling sites that are representative of a single source or in a mixing zone.

6.5.2.2 Select Sample Sites That Meet SMP Criteria

After running your model, select sampling sites similar to required SMP sample sites (see Table 1.1 for a summary of SMP site location criteria; see Chapters 2, 3, and 4 for more details). The residence time, influence zone, and mixing zone information developed through modeling should be used to guide the selection of SMP-type sampling sites. These sites should equal or exceed the required number of SMP sites and satisfy the SMP siting criteria, based on the population served and system type (see Table 1.1 for a summary of SMP sampling requirements). Chapters 2, 3, and 4 include additional considerations for SMP site selection.

6.5.2.3 Perform One Round of Sampling

To meet the requirements of this predefined SSS, you must perform at least one round of sampling at SMP sites. The purpose of this monitoring is to confirm the model predictions of residence time and assist with selection of Stage 2B compliance sites. Further, the behavior of HAA5 cannot always be directly predicted based on residence time in a distribution system, so sampling is needed to confirm the appropriate selection of sites that target high HAA5 concentrations.

If only one round of sampling is performed, it should occur in the month of highest DBP levels or water temperature in your system. Additional rounds of sampling are allowed and encouraged. If more than one round is performed, all results should be considered in the selection of Stage 2B DBPR compliance monitoring sites and included in the IDSE report.

6.5.2.4 Select Final Stage 2B Compliance Monitoring Sites

To select your compliance sites using your water distribution system model and one round of sampling, compare the residence time predictions from your model with the sampling results. Are the results consistent? For example, do those locations with the highest residence time also represent those locations with the highest TTHM concentrations? If you have at least one year’s worth of Stage 1 DBPR compliance monitoring data, you should include these data in your comparison.

After determining that the monitoring results and residence time predictions are consistent, select the appropriate number of Stage 2B monitoring sites. A summary of Stage 2B monitoring requirements is presented in Chapter 5 (Table 5.4). For large systems, if a Stage 1 DBPR site also represents a high TTHM or high HAA5 location, that site can be maintained for the purpose of maintaining a historical database. The example in Appendix G includes this scenario.

6.6 Minimum Requirements for an IDSE SSS Report

Your IDSE SSS report must demonstrate that your SSS provides equivalent or superior Stage 2B site selection as compared to results of an SMP. Specifically, your IDSE SSS report must contain the following—

- All studies, reports, data, analytical results, and modeling results
- Selection of compliance monitoring sites
- Justification for selection of Stage 2B DBPR sites

The report should present a map of your water model with residence time clearly noted, all monitoring sites shown, and your proposed Stage 2B compliance sites shown. The report should clearly present the rationale for selecting each Stage 2B compliance site based on the historical data modeling results, or alternative SSS. Appendix G contains an example of an IDSE SSS report.

7.0 Requirements for Systems Not Conducting an IDSE

7.1 Introduction

Systems that are not conducting an IDSE still need to coordinate with their State for exemption approval and selection of Stage 2B DBPR compliance monitoring sites (refer to Section 1.2 for a summary of systems that do not have to conduct an IDSE). As Chapter 1 describes, the Stage 2 DBPR will be implemented in two phases—Stage 2A and Stage 2B. This chapter summarizes monitoring changes from the Stage 1 to the Stage 2 DBPR, focusing on requirements for selection of Stage 2B compliance monitoring sites (Stage 2A compliance monitoring sites remain the same as the Stage 1 sites). This chapter also describes reporting and other requirements for systems that are not conducting an IDSE. The remainder of this chapter is organized as follows—

7.2 Comparison of Stage 1 and Stage 2B DBPR Monitoring Requirements
7.3 Reporting Requirements for Systems not Conducting an IDSE
7.4 Components of an IDSE Report for Systems Under 40/30 Fg/L
7.5 Schedule for Submitting the IDSE Report to the State

7.2 Comparison of Stage 1 and Stage 2B DBPR Monitoring Requirements

Regardless of whether or not an IDSE is conducted, Stage 1 DBPR compliance sites must be evaluated to determine if changes are needed to meet the Stage 2B DBPR monitoring requirements. Table 5.4 compares the monitoring requirements of the Stage 1 and Stage 2B DBPRs. Note that for all system sizes and source water types, criteria for Stage 2B monitoring are different than those for the Stage 1 DBPR. The main differences are—

- Compliance is based on an RAA in the Stage 1 DBPR versus an LRAA in the Stage 2B DBPR.

- Subpart H systems serving 10,000 or more people must have the same number of sites, but requirements for the *types* of sites (e.g., maximum residence time, representative high TTHM/HAA5) are different.

- Subpart H systems serving fewer than 10,000 people and all ground water systems must sample from two sites as opposed to one site under the Stage 1 DBPR. One site must be representative of high TTHM concentrations, and the other must represent high HAA5 concentrations. The Stage 2B DBPR allows for modified monitoring requirements if the high TTHM and high HAA5 occur at the same location. In this instance, only one site would be required, and it could potentially be the Stage 1 DBPR site.

These last two differences are discussed in detail in Sections 7.2.1 and 7.2.2. Section 7.2.3 provides guidelines for selecting new Stage 2B DBPR compliance monitoring sites.

7.2.1 Subpart H systems Serving 10,000 or More People

> The Stage 2B DBPR targets sites with **representative high** TTHM and HAA5 concentrations, while Stage 1 represents spatial and temporal averages in the distribution system.

Although the required number of compliance monitoring sites (4 per plant) remains the same from the Stage 1 to the Stage 2B DBPR, the *type* of sites required are different for subpart H systems serving 10,000 or more people. Most of the Stage 1 DBPR monitoring sites represent average distribution system residence time. Stage 2B DBPR monitoring sites primarily target sites with representative high TTHM and HAA5 concentrations. Specifically, Stage 2B DBPR requires (on a per plant basis) one site representing high HAA5 concentrations and two sites representing high TTHM concentrations. The Stage 1 DBPR only required one site at maximum residence time and the other three representative of the distribution system average residence time.

High TTHM most often occurs at the maximum residence time, so it is likely that one of the Stage 1 DBPR sites represents high TTHM. Also, one of the Stage 2B sites represents average residence time of the distribution system and must be selected from one of the existing Stage 1 DBPR average/representative sites for historical reference.

Other sites have to be determined from the SMP or SSS evaluation. Even if an IDSE is not conducted, it is likely that at least one new representative high TTHM site for Stage 2B needs to be selected. A high HAA5 site may also need to be selected. Section 7.2.3 discusses resources available for identifying new Stage 2B DBPR compliance monitoring sites.

7.2.2 Situations Where High TTHM and HAA5 Do Not Occur at the Same Location

If a system is a Subpart H system serving fewer than 10,000 people or a ground water system, sites must be representative of both high TTHM and high HAA5. In some cases, it may be possible to represent highest TTHM and HAA5 concentrations with one monitoring site. In these cases, the Stage 2B DBPR allows modified monitoring—only one sample site is required.

Possible scenarios that indicate that the highest TTHM and HAA5 concentrations may not occur at the same location include—

- Inability to maintain a disinfectant residual in all parts of the system. Areas with very low or no disinfectant residual can have long residence times and biological activity. Since there is a higher likelihood of HAA5 to be biodegradable whereas TTHM is not considered to be biodegradable, HAA5 concentrations may deplete in these locations with very low or no disinfectant residual. Therefore, another location with low (0.2 mg/L for chlorine and 0.5 mg/L for chloramine) but positive disinfectant residual may have higher HAA5 concentrations.

- High heterotrophic plate count (HPC) results, if HPC data are available. High HPC counts can indicate biological activity or biofilm growth in a part of the system. In some cases, positive coliform results may also indicate biofilm growth (some coliform species have been identified in distribution system biofilms; however positive coliform results are typically associated with system contamination, so these data should be viewed with caution). Areas of biological activity and/or biofilm growth may have lower HAA5 concentrations.

- TTHM concentration is greater than 4 times the HAA5 concentration at the Stage 1 DBPR monitoring site (possibly indicating biodegradation of HAA5 in the system). Data collected from the 1996 Information Collection Rule showed that the difference in TTHM and HAA5 was greater if the maximum TTHM and HAA5 concentrations occurred at different locations in the distribution system, for a given sample period. Based on data collected under the ICR, when the ratio of TTHM to HAA5 was greater than approximately 4:1, the high HAA5 concentration typically occurred at a different location than the high TTHM concentration for the same sample period. This may have been the result of biodegradation of HAA5 in these systems.

TTHM and HAA5 formation depends on many system-specific factors and is not fully understood. High TTHM and HAA5 frequently occur at different locations. However, the presence of one of the above conditions does not necessarily mean that high TTHM and HAA5 occur at different locations. See Appendix A for more information on factors affecting TTHM and HAA5 formation in the distribution system.

7.2.3 How to Select New Stage 2B DBPR Compliance Monitoring Sites

This section provides guidance for selecting Stage 2B DBPR compliance monitoring sites for those systems not conducting an IDSE. As a reminder, if exempt from the IDSE, additional monitoring is *not* required to justify the selection of Stage 2B DBPR compliance sites. It is encouraged, however, to use the best resources available to select appropriate Stage 2B DBPR compliance sites. Additional monitoring is also encouraged if it is felt that more information about certain areas of the system is needed to appropriately select representative high TTHM and HAA5 sites.

Resources

The following resources are helpful in identifying appropriate Stage 2B DBPR compliance monitoring sites—

- Maps
- Historic DBP data
- Water distribution system models
- Tracer studies
- Disinfectant residual data

Selecting Sites

As summarized in Table 5.4, the Stage 2B DBPR requires that all systems monitor from distribution locations representative of—

- High TTHM concentrations
- High HAA5 concentrations

For subpart H systems serving 10,000 or more people, the Stage 2B DBPR also requires monitoring at sites of average residence time.

General guidelines for selecting representative high TTHM and HAA5 concentrations are listed below. These guidelines may not be appropriate for every system since hydraulics, disinfection practices, etc. can vary widely among systems.

- *Location representative of high TTHM—areas with the longest residence time*
  - Areas with low chlorine residuals
  - Areas served by storage tanks
  - Near the last customer in a remote area, but not past the last fire hydrant

- *Location representative of high HAA5*
  - Between the average residence times and maximum residence time
  - Areas with low residuals—0.2 mg/L for chlorine and 0.5 mg/L for chloramines (very low or no chlorine residual could mean that HAA5 biodegredation occurred)
  - Areas that are geographically distant or hydraulically separate from the high TTHM site (don't want to sample water that is relatively the same as the high TTHM site)

For more information on identifying locations representative of high TTHM and high HAA5 concentrations, refer to Chapter 5.

7.3 Reporting Requirements for Systems not Conducting an IDSE

Table 7.1 summarizes the reporting requirements for systems not conducting an IDSE. Changes in site locations from Stage 1 to Stage 2B are also provided in Table 7.1 for background. See Chapter 1 to for further information on determining if your systems need to conduct an IDSE SMP or SSS.

Table 7.1 Reporting Requirements for Systems Not Conducting an IDSE

Systems Not Conducting an IDSE[1]	Site Changes from the Stage 1 to the Stage 2B DBPR [2]	Reporting Requirements
NTNCWSs serving <10,000 people	**Add one site**, unless TTHM and HAA5 site occur at same location	[to be provided]
Any CWS or NTNCWS with all TTHM/ HAA5 data ≤ 40/30 µg/L during the specified period	*Subpart H systems serving ≥ 10,000:* types of sites required are different, review Stage 1 sites in relation to requirements *All other systems:* **Add one site**, unless TTHM and HAA5 site occur at same location	**IDSE Report** *regardless* of whether sites changed from Stage 1 to Stage 2B [3]
CWSs serving < 500 people that receive a waiver	Condition of waiver is that Stage 1 site represents both high TTHM and HAA5, so *no site changes*	No report unless required by the State

[1] See Section 1.3.1 for a list of specific criteria that your system must meet to be exempt from the IDSE
[2] Table 5.4 provides more complete information on site changes from the Stage 1 to the Stage 2 DBPR
[3] If the system meets other exemption criteria (CWS < 500), it may not be necessary to submit a report.

7.4 Components of an IDSE Report for Systems Under 40/30 Fg/L

An IDSE report is required for systems that are exempt from the IDSE monitoring because all their individual TTHM/HAA5 data are less than or equal to 40/30 Fg/L (see Section 1.3.1 for specific criteria that must be met for systems to be exempt under this provision). The report should generally contain system information and supporting data used to select Stage 2B sites. Specifically, the IDSE report must include—

- Schematic of the distribution system
- Copy of current Stage 1 DBPR monitoring plan
- All individual TTHM and HAA5 analytical results from compliance monitoring conducted prior to the period of the IDSE
- Locations selected for Stage 2B compliance monitoring sites
- Justification for selection of Stage 2B compliance monitoring sites

The rationale for site selection should describe why it is believed that the site(s) represents the high TTHM or high HAA5 concentrations in the distribution system. Data that support any decision should be specified. Table 7.2 is a template that systems under 40/30 Fg/L may use for submitting their Stage 2B DBPR IDSE Report. Appendix H provides an example completed report.

Table 7.2 IDSE Report Template for Systems with TTHM/HAA5 Data below 40/30

Stage 2B DBPR IDSE Report	**Date:**
	Prepared by:
Utility Name:	**Utility Contact:**
Utility Address:	**Phone Number:** **Fax Number:** **E-mail address:**

System Type 9 Nontransient noncommunity 9 Community	**Source Water Type** 9 Ground water 9 Surface water 9 Both	If "both" was selected - Is surface water used at least 90 days per year? 9 Yes 9 No
System Size 9 < 500 people 9 500 - 9,999 people 9 $\geq$ 10,000 people	**Source Water Descriptions** ____________________ ____________________	
	Number of treatment plants/aquifers:	

List Stage 2B Sites	**Rationale for Selection** (Attach additional sheets as needed)

(Include a schematic or map of the distribution system identifying the monitoring sites by number, storage facilities, pump stations, treatment plants and entry points)
Are any of these also the Stage 1 DBPR Monitoring Sites? 9 Yes 9 No (Include a copy of the current Stage 1 DBPR monitoring plan) If "yes" - please provide a basis for using the Stage 1 DBPR monitoring sites. ____________________ ____________________ ____________________ ____________________ ____________________ ____________________
All supporting TTHM and HAA5 data must be submitted with this form.

7.5 Schedule for Submitting the IDSE Report

Table 7.3 summarizes when IDSE Reports are due, according to system size and source water type.

Table 7.3 IDSE Report Due Dates

System Characteristics (Population Served)	IDSE Report Due Date [1]
Subpart H systems ($\geq$ 10,000)	[2 years after rule promulgation]
Subpart H systems (500 - 9,999)	[4 years after rule promulgation]
Subpart H systems (< 500)	[4 years after rule promulgation]
Ground water systems ($\geq$ 10,000)	[2 years after rule promulgation]
Ground water systems (< 10,000)	[4 years after rule promulgation]

[1] If the system is a consecutive system, the IDSE Report is due at the same time as the largest system in the combined distribution system.

[Note: actual dates will be added in later drafts of this manual]

8.0 Stage 2 DBPR Compliance Monitoring

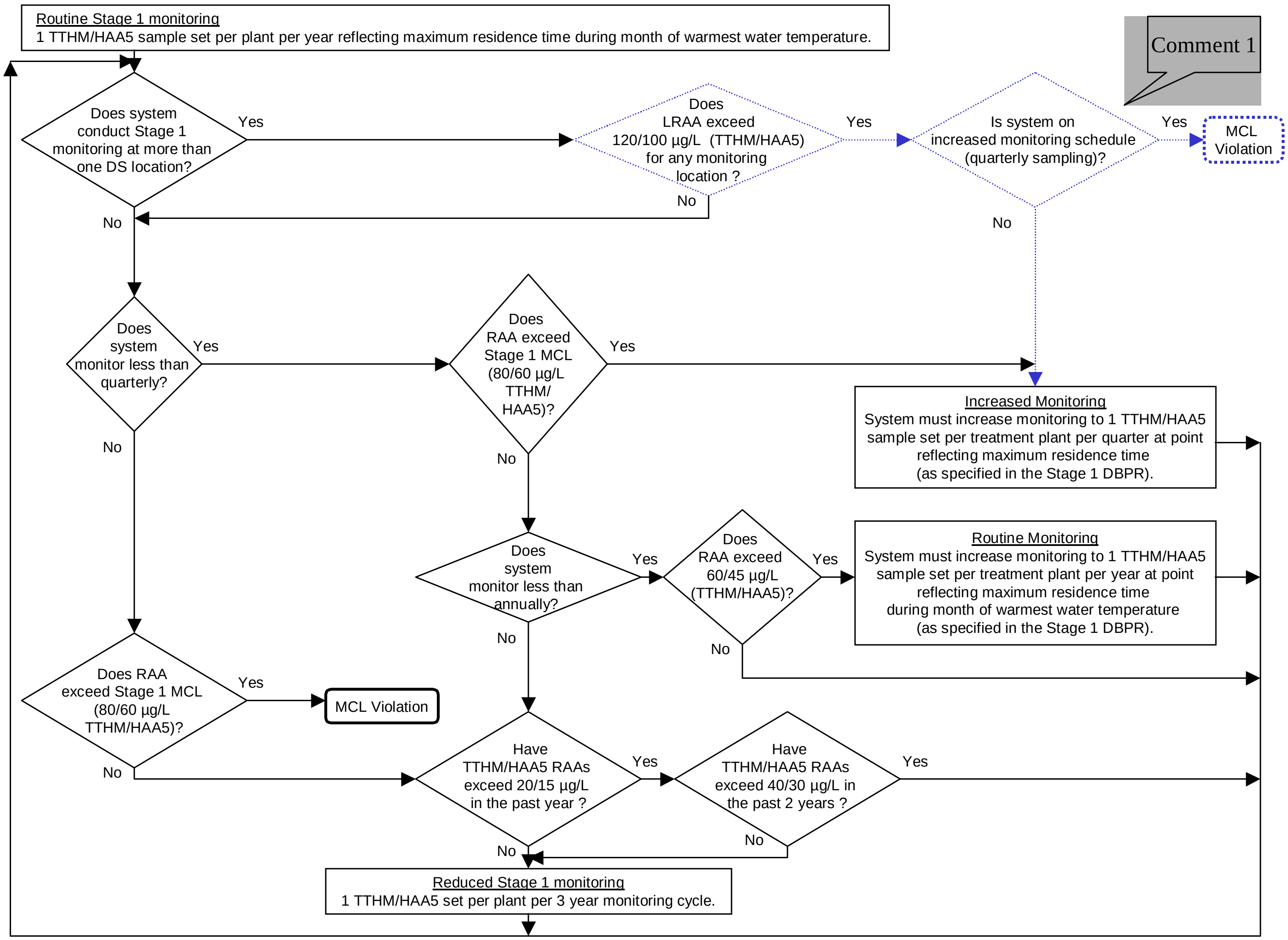
The results of the IDSE determine the locations to be monitored for compliance with the TTHM and HAA5 maximum contaminant levels (MCLs) under the Stage 2 DBPR. This chapter summarizes other Stage 2 DBPR requirements that are concurrent with and subsequent to the IDSE.

8.1 Other Stage 2A Requirements

Systems that must meet the transitional MCLs (systems with more than one Stage 1 DBPR monitoring location for TTHM and HAA5) must continue monitoring at the same frequency and at the same locations as required under the Stage 1 DBPR and must use results from this monitoring to calculate compliance. Systems conducting reduced monitoring under Stage 1 requirements may continue to do so as long as they meet the Stage 1 criteria for reduced monitoring. Systems conducting increased monitoring as a result of an MCL violation must continue to monitor at an increased frequency until they qualify for routine monitoring.

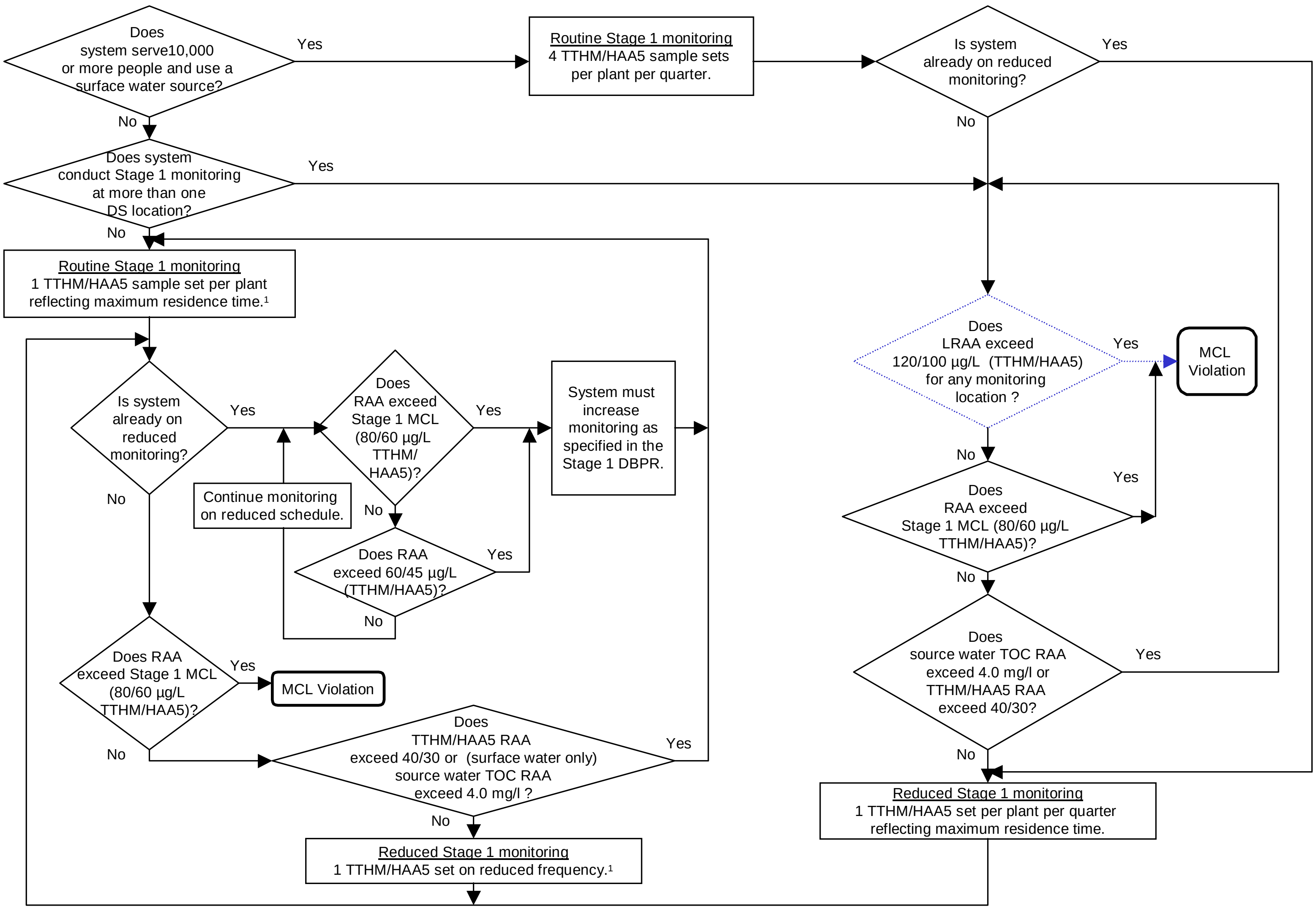
Systems must still comply with Stage 1 DBPR requirements; these are shown in Charts 2 and 3. Chart 2 applies to all surface water systems and ground water systems serving ≥ 10,000. Chart 3 applies to ground water systems serving <10,000.

CHART 3: STAGE 2-A DBPR COMPLIANCE*
GW systems serving serving less than 10,000 people



* Stage 2-A flow steps shown with dashed lines. All other steps reflect continued compliance with Stage 1 DBPR requirements.

CHART 2: STAGE 2-A DBPR COMPLIANCE*
GW systems serving 10,000 or more people and All Surface Water Systems



* Stage 2-A flow steps shown with dashed lines. All other steps reflect continued compliance with Stage 1 DBPR requirements.

¹ Frequency of monitoring varies with system size, source type and monitoring schedule (I.e., routine or reduced) which affect timing of compliance calculation, however, it does not impact flowchart pathway

8.2 Other Stage 2B Requirements

The process for complying with Stage 2B requirements is shown in Charts 4-9 at the end of this chapter. The table below lists the charts applicable to each system type.

System Size/Type	Chart
Surface water serving ≥10,000	Chart 4
Surface water serving 500-9,999	Chart 5
Surface water serving <500	Chart 6
Ground water serving ≥ 10,000	Chart 7
Ground water serving 500-9,999	Chart 8
Ground water serving <500	Chart 9

8.2.1 Routine Monitoring

The number and frequency of samples each system must take to demonstrate compliance with the Stage 2B MCLs are shown in Table 8.1.

All systems must develop a monitoring plan, which may be an update of the monitoring plan developed for the Stage 1 DBPR. The plan must reflect the recommendations of each system's IDSE report, unless the State requires otherwise. Systems serving more than 3,300 people must submit their plans to the State; all systems must keep a copy of the plan on file. The following elements must be addressed in the plan—

- Monitoring locations
- Monitoring dates
- Compliance calculation procedures
- Monitoring plans for any other systems in the combined distribution system
- Any permits, contracts, or agreements with third parties (including other systems, laboratories, and State agencies) to sample, analyze, report, or perform any other Stage 2 DBPR monitoring requirement

Table 8.1 Stage 2B Compliance Monitoring Frequencies and Locations

IF YOU ARE THIS TYPE OF SYSTEM (3)	THEN YOU MUST MONITOR (5)	AT THESE LOCATIONS FOR EACH PLANT (4)
Subpart H serving ≥ 10,000	four dual samples per quarter per plant, taken approximately every 90 days. One quarterly set must be taken during the peak historical month for DBP concentrations.	-locations recommended to the State in the IDSE report submitted under §141.1015
Subpart H serving 500-9,999	two dual samples per quarter per plant, taken approximately every 90 days. One quarterly set must be taken during the peak historical month for DBP concentrations.	-locations recommended to the State in the IDSE report submitted under §141.1015 (1)
Subpart H serving <500	one TTHM and one HAA5 sample per year per plant, taken during the peak historical month for DBP concentrations.	-locations recommended to the State in the IDSE report submitted under §141.1015 (2)
Groundwater serving ≥ 10,000	two dual samples per quarter per plant, taken approximately every 90 days. One quarterly set must be taken during the peak historical month for DBP concentrations.	-locations recommended to the State in the IDSE report submitted under §141.1015 (1)
Groundwater serving 500-9,999	two dual samples per year per plant, taken during the peak historical month for DBP concentrations.	-locations recommended to the State in the IDSE report submitted under §141.1015 (1)
Groundwater serving <500	one TTHM and one HAA5 sample per year per plant, taken during the peak historical month for DBP concentrations.	-locations recommended to the State in the IDSE report submitted under §141.1015 (2)

(1) After approval by the State, systems with a single location that has both the highest TTHM LRAA and highest HAA5 LRAA may take a dual sample only at that location.
(2) Systems are required to sample for both TTHM and HAA5 at one location if that location is the highest for both TTHM and HAA5. If different locations have high TTHM and HAA5 LRAAs, the system may sample for TTHM only at the high TTHM location and for HAA5 only at the high HAA5 location. If the system has received a waiver for IDSE monitoring from the State under §141.1012(c), the system must monitor for TTHM and HAA5 at the subpart L monitoring location (a point representative of maximum residence time) during the month of warmest water temperature.
(3) Consecutive systems must monitor based on their own population and source water, except that consecutive systems that receive water from a subpart H system must monitor as a subpart H system.
(4) Unless the State has approved or required other locations or additional locations based on the IDSE report.
(5) "Dual sample" means two samples are collected at the same time at each location and one is analyzed for TTHM and the other for HAA5.

8.2.2 Reduced and Increased Monitoring and Significant Excursions

Surface water systems serving 500 or more people may qualify for reduced monitoring frequencies if their TTHM LRAAs are ≤ 40 Fg/L, their HAA5 LRAAs are ≤ 30 Fg/L, and their source water annual average TOC level is ≤ 4.0 mg/L. Surface water systems serving fewer than

500 people may not reduce monitoring. The reduced monitoring frequencies and locations for surface water systems are shown in Charts 4 and 5.

Ground water systems of any size may qualify for reduced monitoring if their TTHM and HAA5 LRAAs are all below 40/30 Fg/L. Specifics are shown in Charts 7-9.

Consecutive systems may reduce monitoring based on their population and the wholesale system's source water type.

To remain on reduced monitoring, systems must continue meeting the 40/30 Fg/L LRAAs for plants monitoring quarterly (or each individual TTHM sample must be ≤ 60 Fg/L and HAA5 ≤ 45 for systems monitoring annually). Surface water systems must continue to have TOC levels ≤ 4.0 mg/L.

Systems with routine monitoring frequencies of annually or less than annually at each location must increase monitoring frequency to quarterly at all locations if any sample result exceeds 80 Fg/L for TTHM or 60 Fg/L for HAA5. Systems may return to routine monitoring if they have monitored quarterly for at least four quarters and the LRAA for every location is ≤ 60 Fg/L for TTHM and 45 Fg/L for HAA5.

Significant excursions occur when any individual sample exceeds 100 Fg/L for TTHM or 75 Fg/L for HAA5, even if the system is still in compliance with the TTHM and HAA5 MCLs. Systems with significant excursions must conduct a significant excursion evaluation and discuss the evaluation with their States no later than the date of their next sanitary surveys.

8.2.3 Special Circumstances

Systems with more than one treatment plant must monitor all locations in the distribution system at the frequency required for the plant required to sample most frequently. The State may approve a modified monitoring frequency for any plant, as long as the frequency is not less than the frequency that would be required if the plant were the only plant in the system.

Systems that blend water from ground water and surface water sources in the distribution system must monitor all locations in the distribution system at the frequency required for the plant required to sample most frequently. The State may approve a modified monitoring frequency, as described in the previous paragraph.

8.2.4 Reporting Requirements

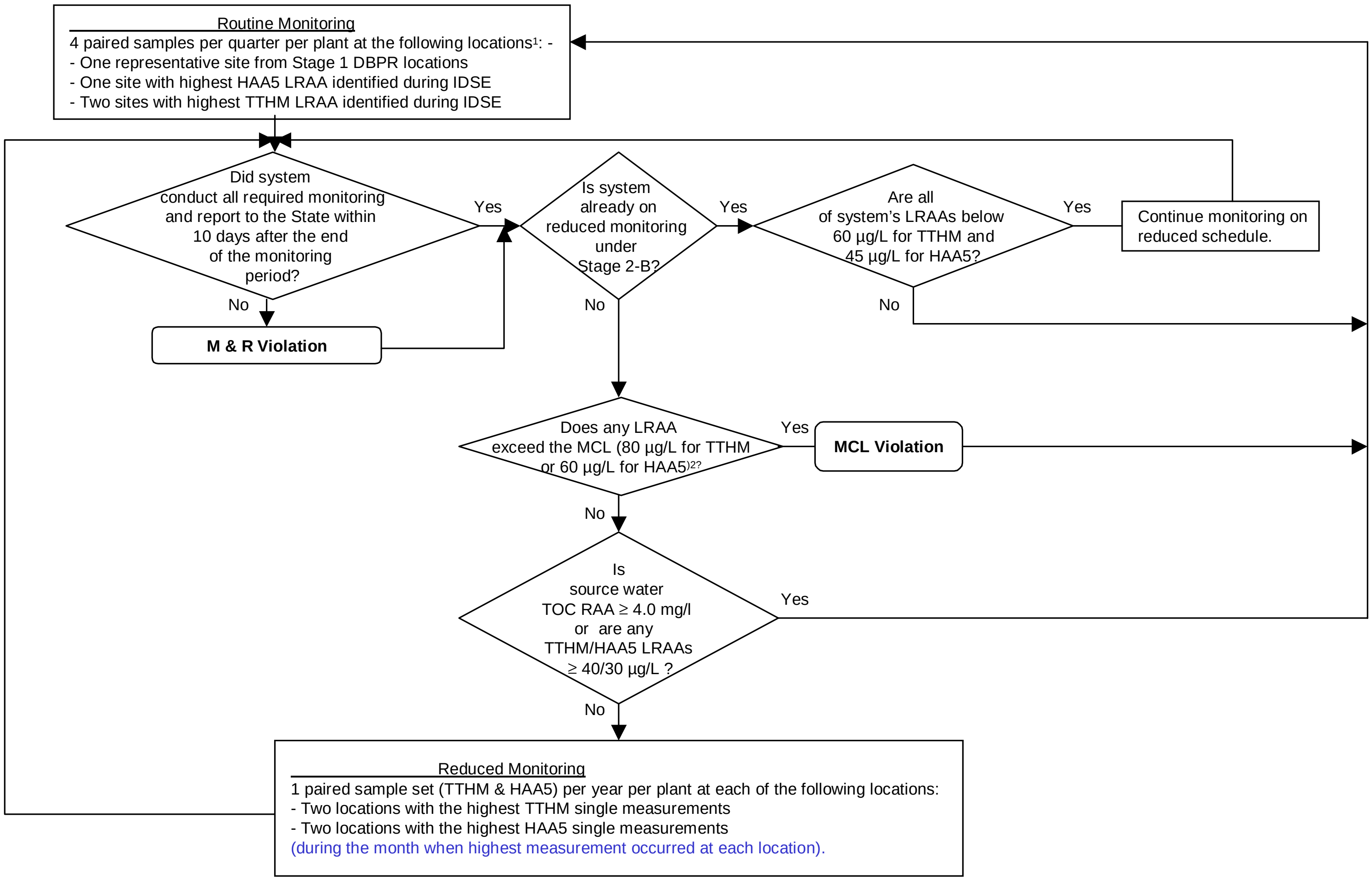
Within ten days of the end of any quarter in which monitoring is required, systems must report the following to the State—

- Number of samples taken at each location during the last quarter
- Location, date, and results of each sample

- LRAA at each location based on the last four quarters
- Whether the MCL was exceeded at any location
- Whether there were any significant excursions in the last quarter

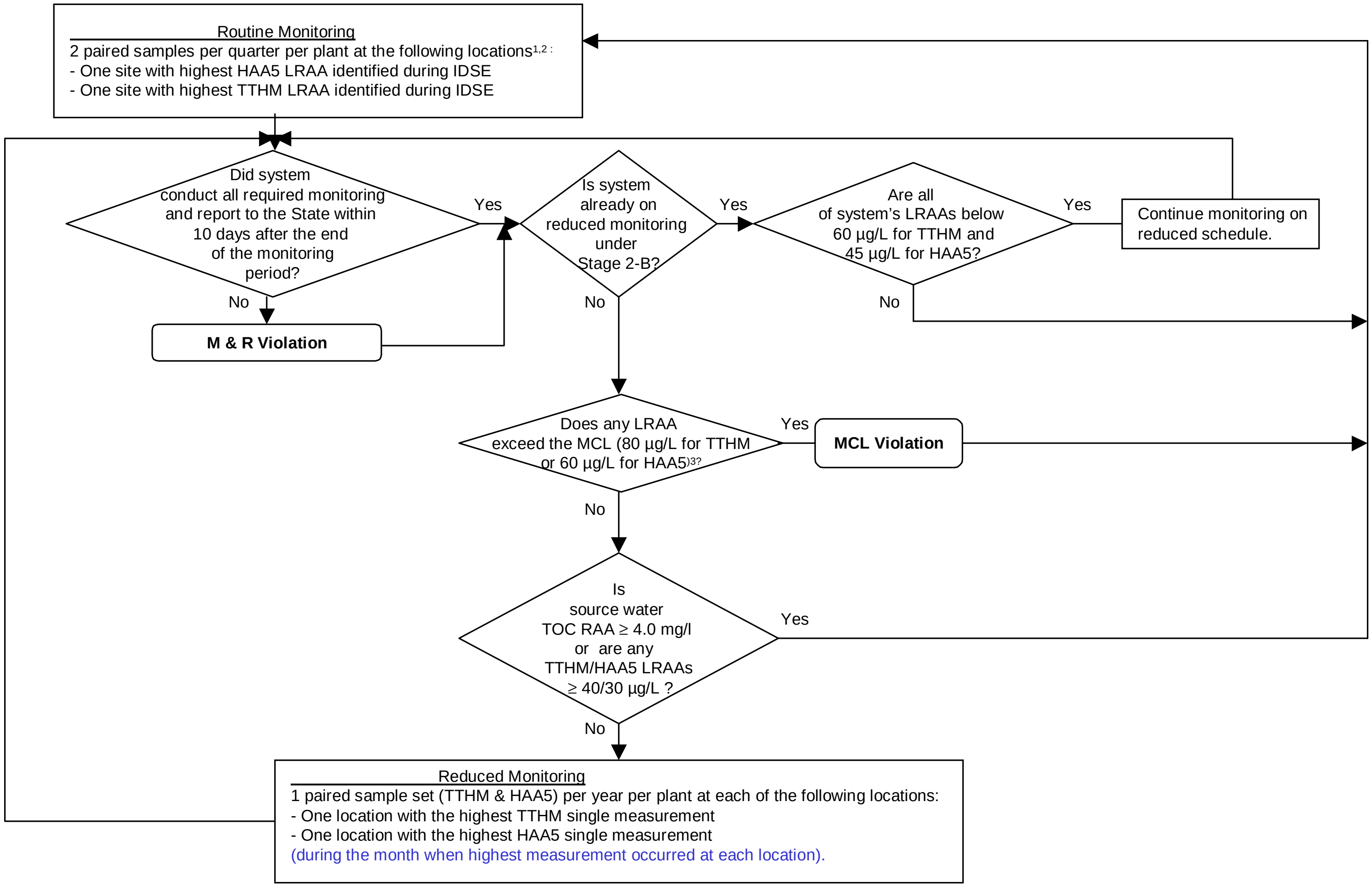
For surface water systems on reduced monitoring schedules, reports must also include information on the number, date, location, quarterly average, and RAA of source water TOC levels.

CHART 4: STAGE 2-B DBPR COMPLIANCE
Subpart H systems serving 10,000 or more people.



[1] Quarterly samples must be taken approximately every 90 days. One quarterly set must be taken during the peak historical month for DBP concentrations.
[2] In the first year of Stage 2-B compliance monitoring, if the sum of fewer than four quarters of data for any location exceed 32 µg/L for TTHM or 24 µg/L for HAA5 such that the LRAA for the first year of compliance will exceed the MCL (80 µg/L for TTHM or 60 µg/L for HAA5), the system is immediately in violation of the rule.

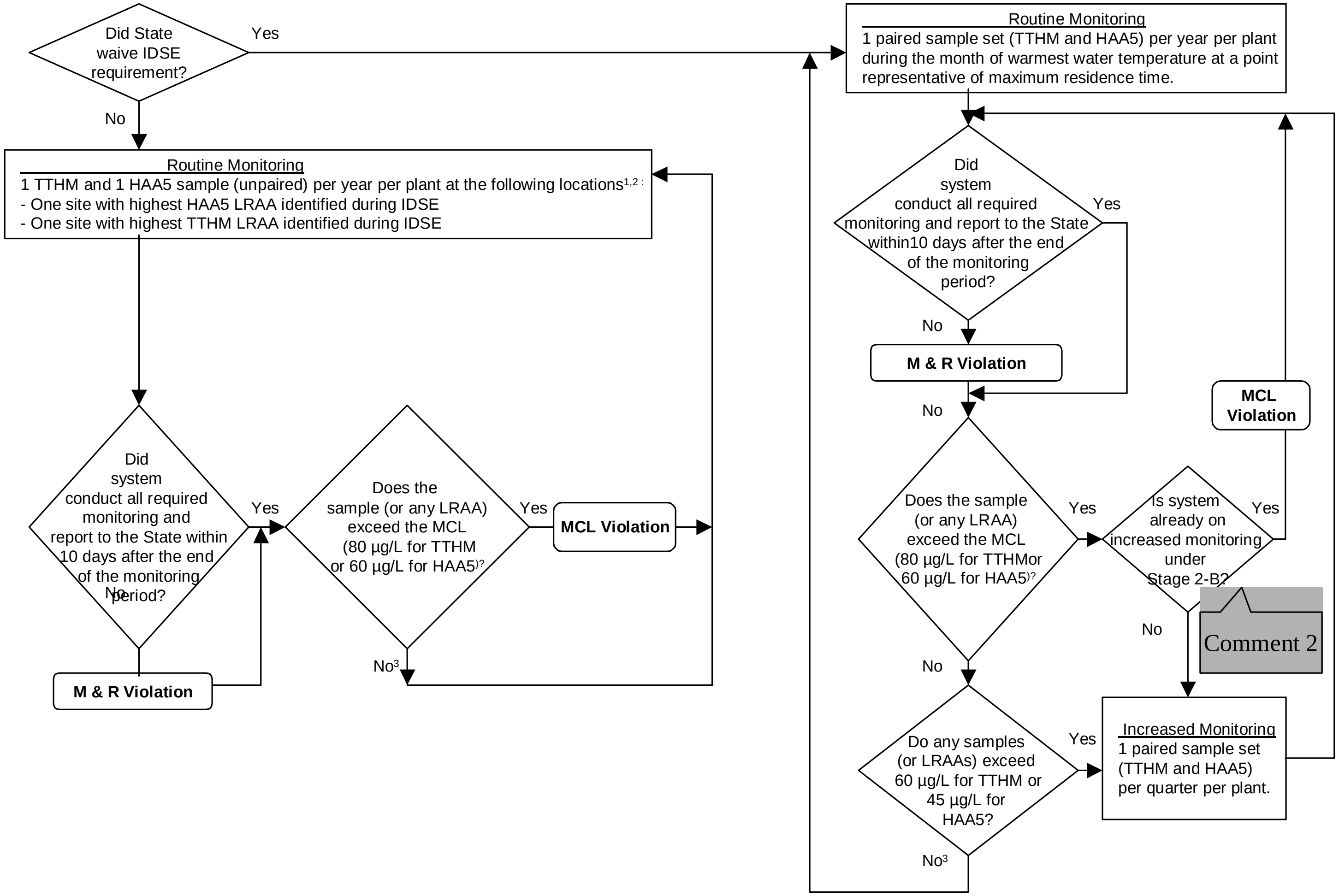
CHART 5: STAGE 2-B DBPR COMPLIANCE
Subpart H systems serving 500 - 9,999 people.



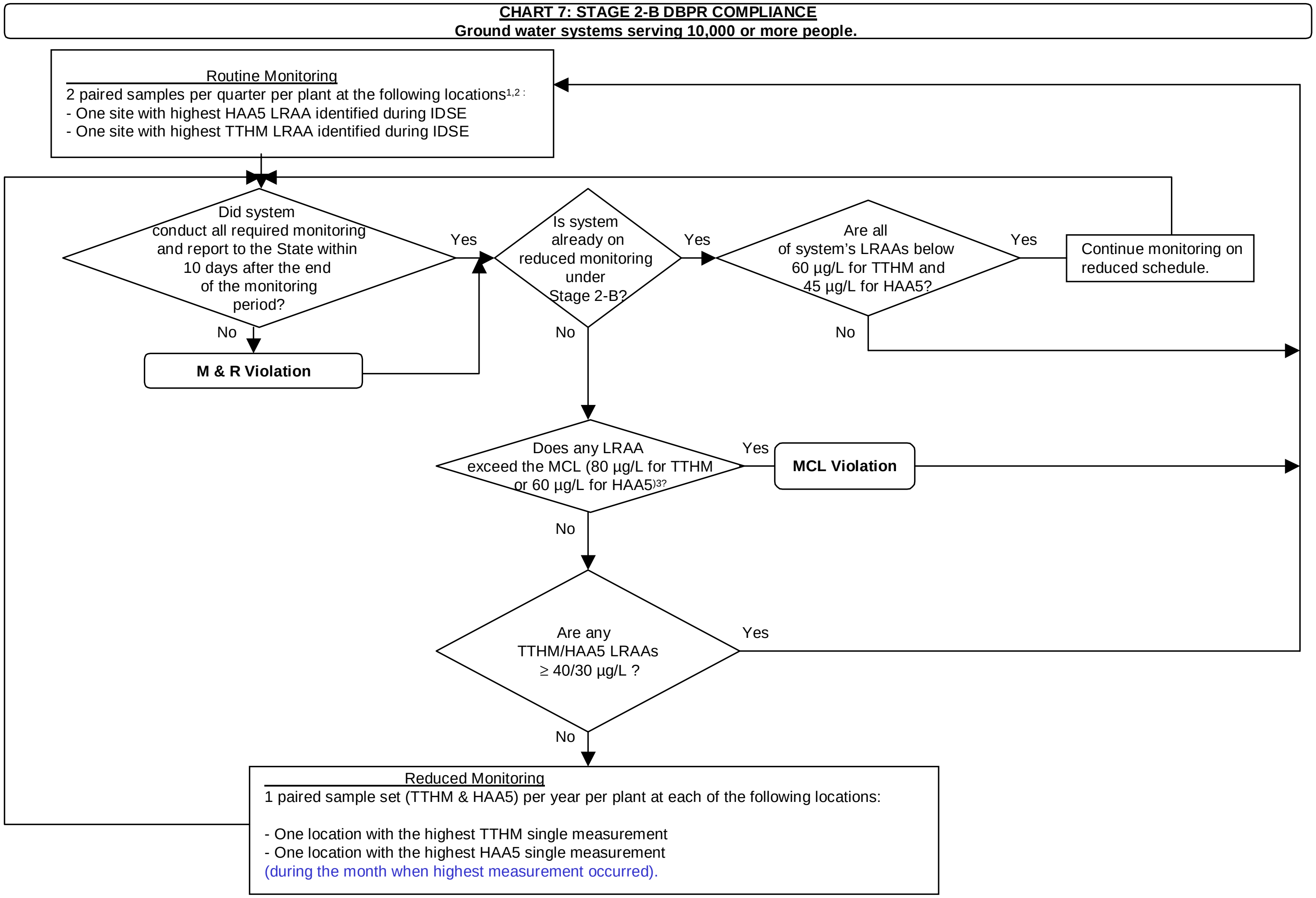
[1] Quarterly samples must be taken approximately every 90 days. One quarterly set must be taken during the peak historical month for DBP concentrations.
[2] After approval by the State, systems with a single location that has both the highest TTHM LRAA and highest HAA5 LRAA may take a paired sample only at that location.
[3] In the first year of Stage 2-B compliance monitoring, if the sum of fewer than four quarters of data for any location exceed 32 µg/L for TTHM or 24 µg/L for HAA5 such that the LRAA for the first year of compliance will exceed the MCL (80 µg/L for TTHM or 60 µg/L for HAA5), the system is immediately in violation of the rule.

1

CHART 6: STAGE 2-B DBPR COMPLIANCE
Subpart H systems serving fewer than 500 people.

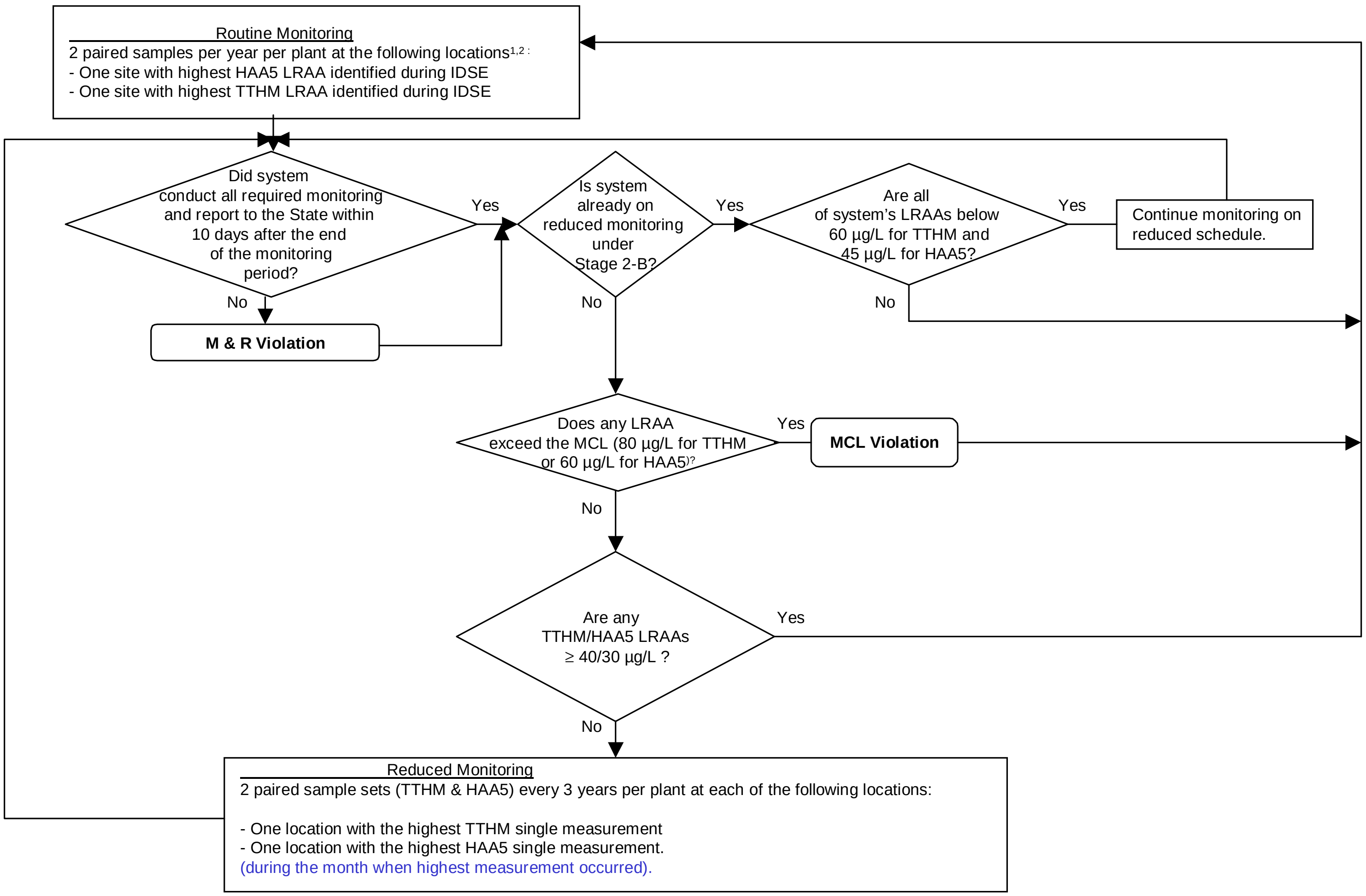


[1] Samples must be taken during the peak historical month for DBP concentrations.
[2] Systems required to sample for both TTHM and HAA5 at one location only if both TTHM and HAA5 are both highest at that location. If highs are at different locations, the system must sample for TTHM only at the high TTHM location and HAA5 only at the high HAA5 location. If the State has waived IDSE monitoring, the system must sample during the month of warmest water temperature at a point representative of maximum residence time.
[3]Systems can not reduce monitoring.



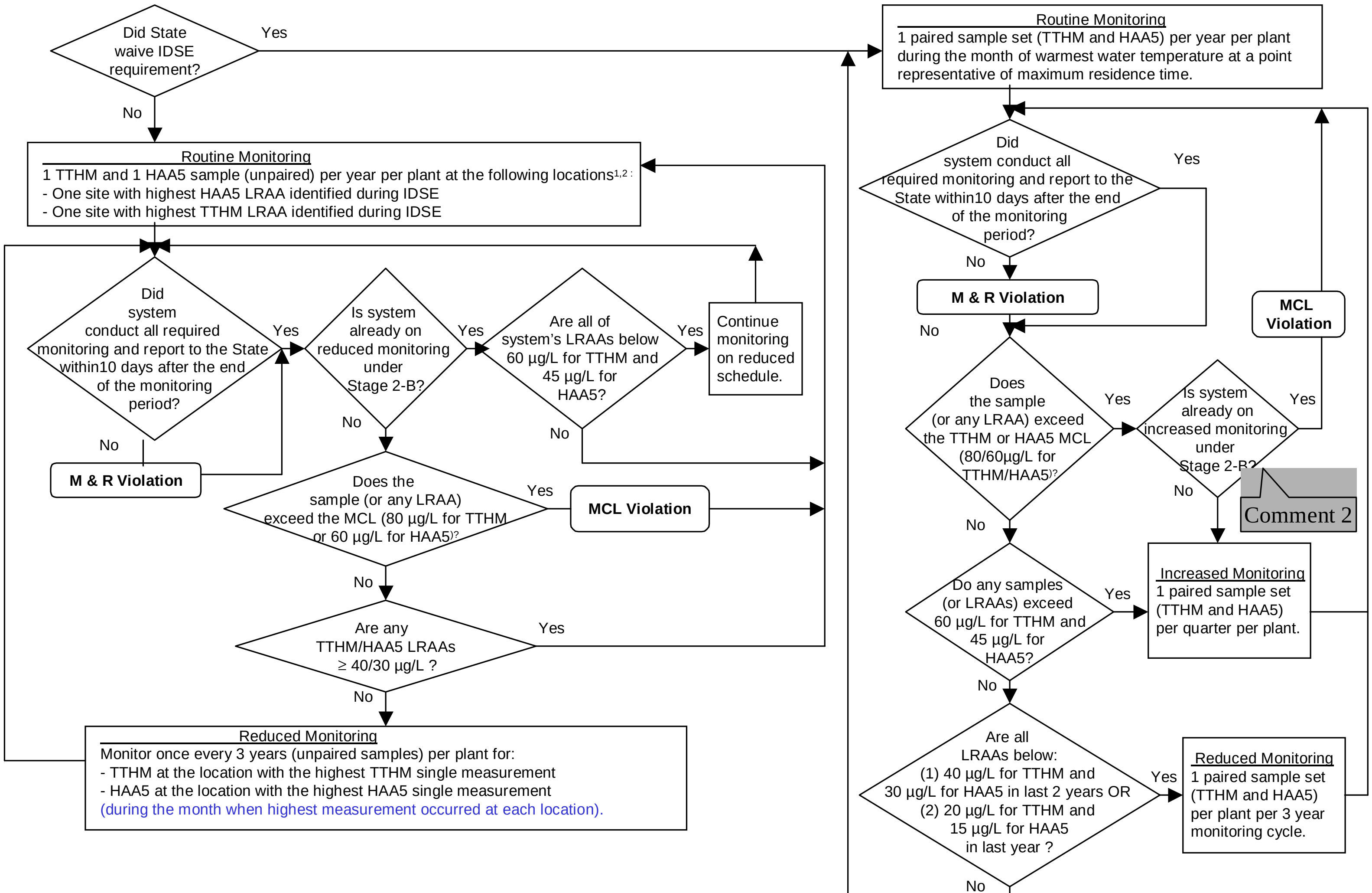
[1] Quarterly samples must be taken approximately every 90 days. One quarterly set must be taken during the peak historical month for DBP concentrations.
[2] After approval by the State, systems with a single location that has both the highest TTHM LRAA and highest HAA5 LRAA may take a paired sample only at that location.
[3] In the first year of Stage 2-B compliance monitoring, if the sum of fewer than four quarters of data for any location exceed 32 µg/L for TTHM or 24 µg/L for HAA5 such that the LRAA for the first year of compliance will exceed the MCL (80 µg/L for TTHM or 60 µg/L for HAA5), the system is immediately in violation of the rule.

CHART 8: STAGE 2-B DBPR COMPLIANCE
Ground water systems serving 500 - 9,999 people.



[1] Sample sets must be taken during the peak historical month for DBP concentrations.
[2] After approval by the State, systems with a single location that has both the highest TTHM LRAA and highest HAA5 LRAA may take a paired sample only at that location.

CHART 9: STAGE 2-B DBPR COMPLIANCE
Ground water systems serving fewer than 500 people.



[1] Samples must be taken during the peak historical month for DBP concentrations.

[2] Systems required to sample for both TTHM and HAA5 at one location only if both TTHM and HAA5 are both highest at that location. If highs are at different locations, the system must sample for TTHM only at the high TTHM location and HAA5 only at the high HAA5 location. If the State has waived IDSE monitoring, the system must sample during the month of warmest water temperature at a point representative of maximum residence time.

Appendix A

Formation and Control of Organic Disinfection Byproducts

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A.1 Formation of DBPs

Organic disinfection (and oxidation) byproducts are formed by the reaction between organic substances and oxidizing agents that are added during water treatment. In most water sources, natural organic matter (NOM) is the major constituent of organic substances and DBP precursors. Major factors affecting the type and amount of DBPs formed include—

- Type of disinfectant, dose, and residual concentration
- Contact time and mixing conditions between disinfectant (oxidant) and precursors
- Concentration and characteristics of precursors
- Water temperature
- Water chemistry (including pH, bromide ion concentration, organic nitrogen concentration, and presence of other reducing agents such as iron and manganese)

A description of these factors follows.

Impact of disinfection method on organic DBP formation

Organic DBPs can be subdivided into halogenated and non-halogenated byproducts.

Halogenated organic disinfection byproducts are formed when organic compounds found in water react with free chlorine, free bromine, and/or free iodine (NOTE to Alessandro/Chris: Iodinated DBPs are becoming an issue persued by the DBP research community, and iodine is a halide). The formation reactions may take place in the treatment plant and/or the distribution system. Free chlorine can be introduced to water directly as a primary or secondary disinfectant, or as a byproduct of the manufacturing of chlorine dioxide and chloramines. Reactions between NOM and chlorine lead to the formation of a variety of halogenated DBPs including THMs and HAAs.

Free chlorine and ozone oxidize bromide ion to hypobromite ion/hypobromous acid, which in turn can react with NOM to form brominated DBPs (e.g. bromoform). The presence of bromide affects both the rate and yield of DBPs. As the ratio of bromide to NOM (measured as total organic carbon) increases, the percentage of brominated DBPs increases; i.e., the rate of THM formation is higher in waters with increased concentrations of bromide (Krasner, 1999). Oxidation of organic nitrogen can lead to the formation of DBPs containing nitrogen (e.g. haloacetonitriles, halopicrins, and cyanogens halide; Reckhow et al., 1990; Hoigné and Bader, 1988). Brominated DBPs can also form by bromine substitution in the chlorinated by products. Hypobromous acid is a more effective substituting agent, while hypochlorous acid is a better oxidant (Krasner, 1999).

Non-halogenated DBPs may form when precursors react with strong oxidants. For example, the reaction of organics with ozone and hydrogen peroxide results in the formation of aldehydes, aldo- and keto-acids, and organic acids (Singer, 1992). Chlorine can also trigger the formation of some non-halogenated DBPs (Singer and Harrington, 1993). Many of the non-halogenated DBPs are biodegradable.

Studies have documented that chloramines produce significantly lower DBP levels than free chlorine, and there is no clear evidence that the reaction of NOM and chloramine leads to the formation of THMs (Singer and Reckhow, 1999; EPA, 1999). Predictions of an empirical DBP formation model calibrated using ICR data indicated that THMs and HAAs are formed in full-scale plants and distribution systems under chloraminated conditions as a fraction of the amount that would be expected based on observations of DBP formation under free chlorine conditions. The amount of formation with chloramines varied from 5% to 35% of that calculated for free chlorine, depending on the individual DBP species (Swanson et al, 2001).

It is possible that DBPs might form during the mixing of chlorine and ammonia, when free chlorine might react with NOM before the complete formation of chloramines. In addition, monochloramine slowly hydrolyzes to release free chlorine in water. This free chlorine may contribute to the formation small amounts of additional DBPs in the distribution system. The benefits of low DBP formation with chloramines are especially important at the extremities of the system where high DBP levels can found.

The application of chlorine dioxide does not produce significant amounts of organic halogenated DBPs. Only small amounts of total organic halides (TOXs, the class of halogenated organic by-products that includes THMs and HAAs) are formed. However, THMs and HAAs will form if excess chlorine is added to water to ensure complete reaction with sodium chlorite during the production of chlorine dioxide.

To date, there is no evidence to suggest that ultra violet (UV) irradiation results in the formation of any disinfection byproducts; however, little research has been performed in this area. Most of the research regarding application of UV light and DBP formation has focused on the impact on chlorinated DBP formation as a result of UV application prior to the addition of chlorine or chloramines.. The evidence suggests UV light does not change chlorinated DBP formation.

Disinfectant Dose

The concentration of disinfectant can affect the formation of DBPs. In general, changes in the disinfectant dose have a great impact on DBP formation during primary disinfection. This is because the amount of disinfectant added during primary disinfection is usually less than the long-term demand and the disinfectant is the limiting reactant in DBP formation reactions. Although disinfectant dose can affect DBP formation during secondary disinfection, the effect is less significant than in primary disinfection, because during secondary disinfection DBP formation reactions are precursor limited since an excess of disinfectant is added to the water. In the distribution system DBP formation reactions become disinfectant-limited when the chlorine residual drops to low levels (Singer and Reckhow, 1999; suggested 0.3 mg/L as a rule of thumb).

In many systems booster disinfection is applied to raise disinfectant residual concentration, especially in remote areas of the distribution system or near storage tanks where water age may be high and disinfectant residuals can be low. The additional chlorine dose applied to the water at these booster facilities can increase THM and HAA levels. Further, booster chlorination can maintain high HAA concentrations because the increased disinfection residuals can prevent the biodegradation of HAAs.

Time dependency of DBP formation

In general, DBPs continue to form in drinking water as long as disinfectant residuals and reactive DBP precursors are present. Thus, the longer the contact time between disinfectant/oxidant and NOM, the greater the amount of DBPs that can be foormed. This accumulation is a consequence of the formation of THMs and HAAs, and their associated chemical stabilities, which are generally quite high in the disinfected drinking water as long as a significant disinfectant residual is still present (Singer and Reckhow, 1999).

In the distribution system, when the contact time between NOM and disinfectant may be long, DBP levels greater than those in the finished water leaving the plant are often found. High TTHM values usually occur where the water age is the oldest. Unlike THMs, HAAs cannot be consistently related to water age because HAAs are known to biodegrade over time when the disinfectant residual is low. This might result in relatively low HAA concentrations in areas of the distribution system where disinfectant residuals are depleted.

In contrast to chlorination byproducts, ozonation byproducts form more rapidly, but their period of formation is much lower than that of chlorination byproductss(Singer and Reckhow, 1999). This is the result of the quick dissipation of ozone residuals in drinking water treatment plants.

Concentration and characteristics of precursors

In first approximation, the formation of halogenated DBPs is proportional to the concentration of NOM at the point of chlorination. Greater DBP levels are formed in waters with high concentrations of precursors. Studies conducted with different fractions of NOM have indicated the reaction between chlorine and NOM with high aromatic content tends to form higher DBP levels than NOM with low aromatic content. For this reason, ultra violet absorbance (as typically indicated by UV-254, - UV absorbance at 254 nm), which is generally attributed to the aromatic and unsaturated components of NOM, is considered a good predictor of the tendency of a source water to form THMs and HAAs (Owen et al., 1998; Singer and Reckhow, 1999). It should be noted, however, that the more highly aromatic precursors (characterized by high UV-254) in source waters are more easily removed by coagulation. Thus, it is the UV-254 measurement immediately upstream of the point(s) of chlorination within a treatment plant that is more directly related to THM and HAA formation potential.

Water temperature

The rate of formation of THMs and HAAs increases with increasing temperature. Consequentially, the highest THM and HAA levels may occur in the warm summer months. However, water demands are often higher in warmer months, resulting in lower water age within the distribution system and helping to control DBP formation. Furthermore, high temperature conditions in the distribution system promote the accelerated depletion of residual chlorine, which can mitigate DBP formation and promote biodegradation of HAAs (unless chlorine dosages are increased to maintain high residuals). (Singer and Reckhow, 1999). For these reasons, depending on the specific system, the highest THM and HAA levels may be observed during months which are warm, but not necessarily the warmest.

Seasonal trends affect differently where high THM and HAA concentrations might be found. For example, when water is colder, microbial activity is typically lower and DBP formation kinetics are slower. Under these conditions, the highest THM and HAA concentrations might appear coincident with the oldest water in the system. In warmer water, the highest HAA concentrations might appear in fresher water, which is likely to contain higher disinfectant residuals that can prevent the biodegradation of HAAs.

Water pH

In the presence of NOM and chlorine, THM formation increases with increasing pH, whereas the formation of HAAs and other DBPs increase with decreasing pH. The increase of THMs at higher pH values is likely due to base catalyzed reactions that lead to THM formation.. HAA formation pathway can be altered at high pH since their precursors can hydrolyze (Singer and Reckhow, 1999).

The major byproducts of ozonation are not affected by base hydrolysis. However, the rate of decomposition of ozone to hydroxyl radical is accelerated as pH increases. This occurrence is thought to be responsible for the decrease of some byproducts (e.g. aldeydes) and the increase of others (e.g. carbonyl byproduct and total organic halides; Singer and Reckhow, 1999). The application of ozone to bromide containing waters leads to the formation of hypobromite and hypobromous acid. At low pH, the equilibrium shifts to hypobromous acid which can react with NOM to form halogenated byproducts such as bromoform and dibromoacetic acid (Singer and Reckhow, 1999).

A.2 Control of DBPs

Alternatives to minimize the formation of DBPs focus on the removal of precursors (NOM), modifications of the oxidation and disinfection processes, control of oxidants dose and residual, reduction of the residence time in the distribution system, and removal of DBPs after formation. Because DBPs are difficult to remove after they have formed, control strategies typically focus on the first four methods.

Improving Precursors Removal

Removing precursors can reduce the formation of DBPs. The removal of organic precursors can be improved by optimizing coagulation practices or by employing advanced precursor removal processes such as GAC (granular activated carbon) adsorption (Owen et al., 1998) and membrane filtration. The process of improving the removal of NOM during a coagulation process is defined as Enhanced Coagulation. Greater NOM removal can be obtained with adjustments in treatment practice: specifically pH reduction and/or increased coagulant dosage. The coagulation of NOM appears to be most efficient in the 5 to 6 pH range. Watershed management practices can also achieve some reduction of DBP precursors in the raw water.

Disinfection and Oxidation Methods and Disinfectant Dose

Chlorination generally produces the highest THM and HAA levels. Chemicals and methods for primary and secondary disinfection, and oxidation alternatives to chlorine (e.g. use of ozone, chloramines, chlorine dioxide, potassium permanganate, UV radiation, and membrane filtration) can be used to reduce the amount of DBPs and modify their composition. Disinfectant dose and residual affect DBP formation. Generally, decreasing the disinfectant dose and residual reduces DBP levels (see section A.1).

Shifting the Point of Chlorine Addition

Shifting the point of chlorine addition from upstream to downstream of coagulation/settling process can reduce the formation of chlorinated DBPs for two main reasons: the contact time between chlorine and NOM is reduced, and the amount of precursors is reduced prior to chlorine addition. The implementation of this strategy must, however, take into account disinfection needs. Adequate contact time must be provided after the chlorine application point to achieve the desired inactivation of microorganisms.

Control of DBP Formation in the Distribution System

For systems maintaining free chlorine residual, significant DBP formation can occur in the distribution system. A long detention time in the distribution system, the presence of NOM in the finished water and the presence of free chlorine residual can promote this formation. It is not uncommon that water leaving a treatment plant with low THM and HAA concentrations is found to have high levels of these compounds in the distribution system. Generally, application of secondary disinfectant (chlorine or chloramine) to yield residual in the distribution system results in DBP formation. Implementation of distribution system water quality monitoring, minimization of the occurrence of "dead ends," optimization of storage tank utilization, and execution of frequent system flushing can minimize DBP problems in the distribution system.

In some cases, booster chlorination has also been used to control disinfectant application and minimize DBP formation. For example, where the majority of the distribution system is in a confined area near the plant, but a small part is far away from the plant. A large dose of disinfectant would be required to maintain a residual in the extreme part of the system. A much higher residual concentration would be added to what the majority of the system requires. Thus, booster disinfection in the extreme part of the system could dramatically reduce the disinfectant dose at the plant and reduce DBP formation through the system. However, it must also be noted that in areas following booster disinfection facilities, the residence time is often long and, because of the additional disinfectant added, TTHM and HAA tend to be high. Further, HAA concentrations can be high because increased disinfectant residual can prevent biodegradation of HAA.

Assessing DBP Formation and Control with the WTP Model

If a utility determines, based upon distribution system monitoring, that the DBP levels in their system need to be reduced, they may consider implementing treatment changes in their WTP. To evaluate the potential impact of treatment changes on distribution system DBP levels prior to the implementation of these changes, a system may consider using the Water Treatment Plant Simulation Model (WTP Model) as a preliminary tool. This model was initially developed to support the DBP rule making process and was later revised to improve the predictive accuracy using data collected under the Information Collection Rule (ICR). The WTP Model consists of empirical models developed from bench-, pilot-, and full-scale treatability data. The majority of the predictive algorithms have been verified with independent data sets (Solarik, et al, 1999), and many key algorithms have been calibrated using ICR data from full-scale surface water treatment plants (Swanson, et al, 2001). A description of the original model was presented by Harrington, et al (1992) and is available from USEPA's Technical Support Center (TSC) in Cincinnati. However, a significantly improved form of the WTP Model (Version 2.0) is currently under review by the agency and will likely be available in late 2001 from the TSC.

In addition to simulating the effects of traditional surface water treatment processes, such as coagulation (or lime softening), flocculation, sedimentation, and filtration, the WTP Model supports many advanced disinfection and DBP control processes, such as—

- Enhanced coagulation
- GAC adsorption
- Microfiltration/ultrafiltration
- Nanofiltration/reverse osmosis
- Ozonation
- Biological filtration
- Chlorine dioxide addition

The WTP Model generates predictions of bromate formation during ozonation, chlorite formation during chlorine dioxide addition, and THM, HAA, and TOX formation due to free chlorine and chloramine addition. These predictions are generated at the effluent of each unit treatment process and within the distribution system (detention times are required as inputs). The WTP Model also calculates CT achieved values for the various disinfectants used during treatment and log inactivation values for virus, *Giardia*, and *Cryptosporidium*. Thus, the program can be used to evaluate the relative effects of treatment modifications on disinfection and DBP formation.

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Appendix B

Simulated Distribution System (SDS) Test Procedure

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B.1 Introduction

The SDS test involves storing a sample of disinfected finished water in a manner that reflects the conditions (pH, temperature, and residence time) of the distribution system. This test is performed to evaluate the potential of the finished water to form TTHM and HAA5 under the respective distribution system conditions. The SDS test is site-specific and therefore, there is no universal set of conditions that applies to all systems. The selected test conditions will be plant-dependent and should reflect the conditions of the distribution system (pH, temperature and residence time).

It is recommended that the SDS test be done quarterly to include the month with the highest temperature. If less than quarterly tests are performed, then at least one SDS test should be run during the warmest month.

B.2 Recommended SDS Tests

An SDS test can be used as a tool to help describe DBP formation kinetics in distribution systems.

B.2.1 Average and Maximum Residence Times are Defined

If a system has enough information about the residence times (e.g. from tracer studies or model outputs including storage) in their distribution systems, then two SDS tests should be run—

- One using an average distribution system residence time
- One selected to be at 90 percent of the maximum residence time in the distribution system

If the maximum residence time is greater than 5 days, a third SDS test, at a residence time in between the average and maximum residence time, is recommended. This will be valuable in describing the extent of DBP formation. For a more extensive evaluation of the system, a number of samples may be collected to reflect the range of predicted residence times in the distribution system (see Section B.2.2), which is primarily a function of system size and storage and water demand for that time of the year.[1]

For systems that employ booster chlorination in the distribution system, another SDS sample should be taken after the re-chlorination station and the residence time should simulate the distribution system conditions downstream of the re-chlorination station.

B.2.2 Unknown Average and Maximum Residence Times

[1] Grayman W. et al. "Modeling Treated Water Storage Facilities," AWWARF, 2000.

For systems that do not have information about their residence time and cannot conduct SDS tests at the average and maximum residence times, then a number of SDS tests can be conducted to help describe DBP formation kinetics in the system and correspond it to an approximate residence time.

If the system residence time pattern is not well defined but Stage 1 compliance monitoring data are collected then the following SDS procedure will provide an approximate estimate of distribution system contact times. The Stage 1 compliance monitoring data can be used with the SDS kinetic DBP formation results to interpolate or extrapolate to develop a better understanding of the system. It should be noted that, for this analysis to be appropriate, the SDS tests should be conducted in conjunction (preferably done on the same day or a couple of days before) with the Stage 1 DBP compliance monitoring sampling.

Because DBP formation is not linear, it is recommended that a kinetic curve be done to describe the system specific DBP formation. Four samples should be collected at the finished water. Disinfectant residual in the first sample should be quenched immediately and analyzed for TTHM and HAA5 data. This represents time zero. One sample is stored at the finished or distribution system temperature (See Section B.3 for details) for an estimated maximum residence time for the distribution system. This selected time interval will be a best guess estimate. The other two samples are stored for two time intervals that divide the interval between the time zero and the longest estimated residence time in the system. [*Examples to be provided*].

At the end of the selected contact times, the remaining sample disinfectant residuals are quenched (in all three samples - according to the method specifications) and TTHM/HAA5 samples are analyzed. The DBP data and corresponding holding times can then be plotted as follows: the storage contact time (days) is plotted on the x-axis and the DBP concentration data (µg/L) on the y-axis [*Example graph to be provided*]. A comparison of the Stage 1 DBP compliance data from the area of influence of the plant at the time of the SDS sampling, can be done with the data plotted on the graph. For example, the DBP concentration from a sample collected at an estimated average compliance monitoring site can be found on the y-axis. The corresponding residence time can be determined by going across to the line on the plot and then down on the x-axis to get the approximate residence time. Systems can also combine these data with disinfectant residual data from each of the four SDS samples. *[add example on previous graph in different line style*]

B.3 Recommended SDS Test Procedure

The following protocol is recommended for conducting an SDS test—

Test Conditions

- The pH of the sample should be that of the distributed water (± 0.2). No pH adjustments should be done after collecting the finished water samples for any of the SDS tests.

- The sample should be held at a temperature that is comparable to the temperature in the distribution system between the treatment plant and the TTHM sampling points in the distribution system for tat time period. The goal should be to achieve a temperature within ± 2EC of either the water entering the distribution system or the water at a TTHM sampling point. If major temperature fluctuations occur in the distribution system during the SDS tests, these should be taken into account when analyzing the data.

- The storage time of the SDS test should start when the SDS sample is collected. A separate SDS sample should be obtained for each residence time to be evaluated.

Sample Collection

- The SDS sample should be collected at the entry point to the distribution system, after the final addition of chlorine and/or ammonia and after completely mixing with the treated water. (In cases where systems use chloramines for secondary disinfection, SDS sample collection will typically be at the location where the utility measures free ammonia to control the dosing of ammonia).

- The SDS water samples should be collected in 250 mL amber glass bottles (or larger) with TFE-lined screw caps, and should be collected head space-free, with no addition of any preservatives or dechlorinating agents. Prior to collecting the samples, the bottles should be pre-treated with concentrated chlorine solution and copiously rinsed with deionized water, then oven dried at 180 °C for an hour, to ensure that the glassware is chlorine demand free.

Storing the Sample

The bottle containing the SDS sample is best stored in the treatment plant where it is collected.

- It can be suspended in the plant clearwell to maintain it at the finished water temperature, or in a container in a sink with a constant flow of finished or distributed water running through the container.

- The collected sample may be transported to an off-site laboratory, provided it is maintained at the desired storage temperature during transport and for the duration of the test. During the holding time at the laboratory, the SDS sample can be placed in an incubator (set at the selected distribution system temperature ± 2 °C) or in a container in a sink with a constant flow of finished or distributed water running through the container (if the laboratory is a utility laboratory).

Sample Analysis

At the end of a specified residence time, the SDS sample is analyzed for several parameters (disinfectant residual, TTHM, and HAA5).

- The SDS sample should be divided by pouring it into sample bottles containing the appropriate dechlorinating agents/preservatives for each analysis.

    - The TTHM sample bottle should be filled first.
    - Care must be taken to not aerate the sample during this splitting process, in order to prevent the loss of the volatile THMs.

- After the TTHM and HAA5 sample bottles are filled, the pH, temperature, and disinfectant residual concentration should be determined in the remaining aliquot of the SDS sample.

    - If no residual is detected, then the result of this SDS test should be evaluated with caution. If only an average and maximum residence time SDS tests are run (Section B.2.1), the DBP result from an SDS sample without residual disinfectant should not be used and an SDS test for that contact time should be repeated. If a kinetic curve is being described (Section B.2.2), the data point of the sample that had no detectable residual may be plotted on the graph (but qualified as having no residual) and compared to the other three points. Interpolation or extrapolation around that data point my not be as valid.

- The TTHM and HAA5 samples should be analyzed as soon as possible and the DBP concentrations, pH, temperature, residence time and chlorine residual should be reported.

    - The TTHM and HAA5 analyses must be conducted by a laboratory certified under the drinking water certification program to perform those analyses.

Appendix C

IDSE SMP Report for a
Surface Water System Serving $ 10,000 People

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Initial Distribution System Evaluation Report for Elm City

PWSID Number: US1111111

Address: 1234 Main Street
Elm City, US 99999

Contact Person: Mr. Ronald Doe, P.E.

Phone Number: 123-555-0000

Fax Number: 123-555-0001

Email Address: Rdoe@ci.elmcity.us

System Type: Community, surface water

Population Served: 160,000

This appendix is provided as an example IDSE report for surface water systems serving 10,000 or more people and opting to complete the Standard Monitoring Program. The IDSE requirements for these systems are presented in greater detail in Chapter 2.

1. System Description:

General system characteristics:

Service area: Elm City plus surrounding suburban areas
Production: Annual average daily demand 15 MGD

Source Water Information:

Hardwood Lake (surface water)
Softwood River (surface water)
For both sources, water quality data typically range:

- pH: from 6.8 to 7.9
- Alkalinity: from 77 to 94 mg/L as $CaCO_3$
- TOC: from 1.6 to 4.4 mg/L as C
- Bromide: from 0.03 to 0.1 mg/L

Entry points (tied to source(s)) and identification of service area(s) under the influence of each entry point:

Entry points: Hardwood Plant
Softwood River Plant

Customers located in the Elmville, Oakville, Pineville, and south downtown generally receive water from the Hardwood Plant

Customers located in the Cypressville, Cedarville, Poplarville, and north downtown generally receive water from the Softwood Plant

Customers located in the Weeping Willow Community, Appleville, and central downtown generally receive a mixture of water from both plants

Treatment Provided:

Hardwood: conventional
Softwood River: conventional with GAC
Primary and residual disinfection: Chlorine at both plants

Description of distribution system:

Distribution system (estimated length of lines and range of diameter):
About 400 miles, 4" - 56" (approximately 10 MG carrying capacity)

5 storage tanks of 10 MG total capacity
1 ground tank 4 MG capacity
4 elevated tanks 6 MG capacity

Pump stations:
Station #1 is located at the ground storage tank. This pump is primarily used during peak demands and low pressure situations. The pump is timed to turn on in the morning and evening during peak demand, and when the pressure drops below 40 psi at a point downstream of the pump station.

Stations #2 and #3. These pumps are used to boost system pressure when the pressure in the areas downstream of these pumps (Pineville and Polarville) drops below 40 psi.

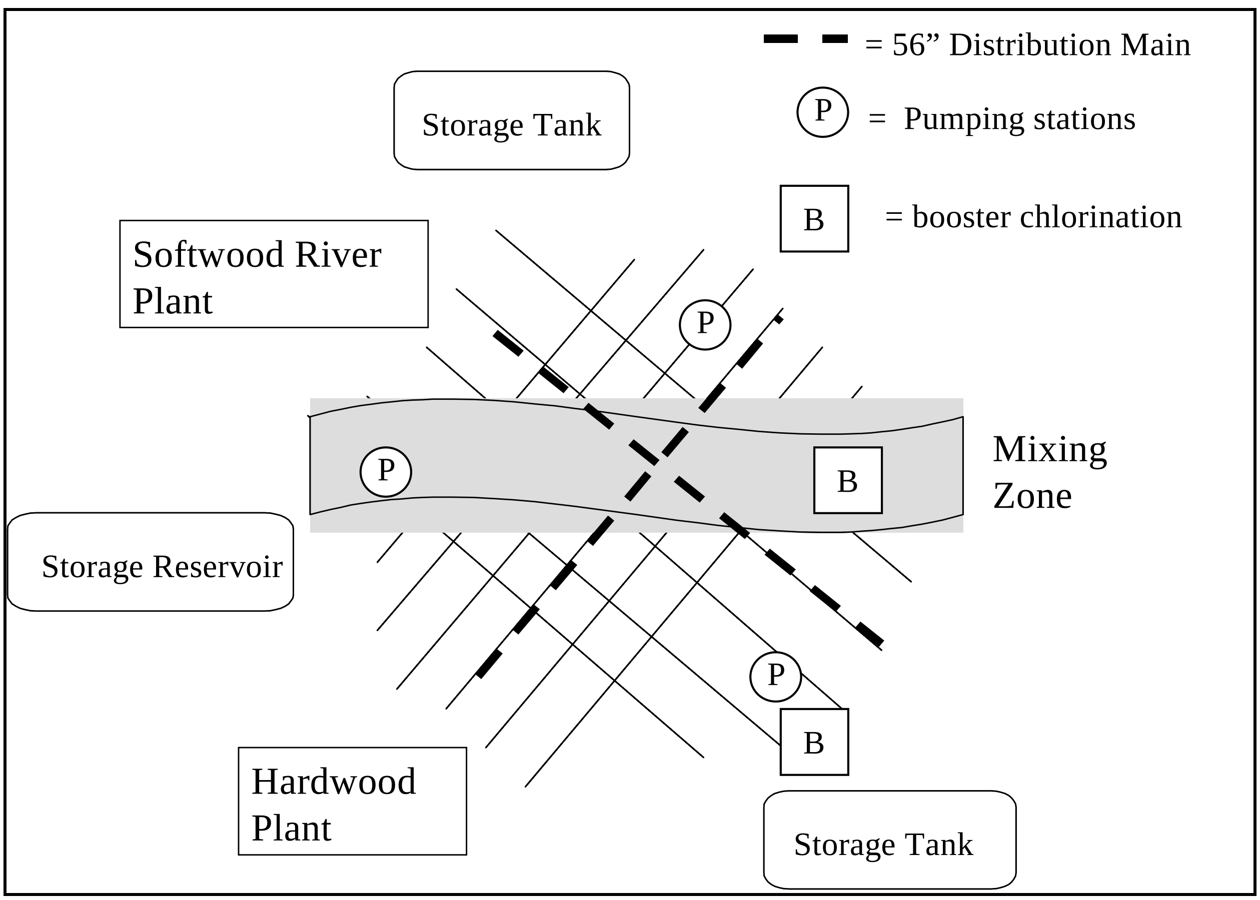
Booster chlorination facilities:
Facility #1 is located on Cherry Hill Ave. (downstream of the Cherry Hill storage tank at pump station #3). This facility is occasionally used during the summer when remote locations downstream of the booster chlorination facility lose residual.

Facility #2 is located at the intersection of Second Ave. and 11th St. (in a mixing zone) in an area of the distribution system where chlorine residuals are frequently low.

2. SMP monitoring requirements:

The system serves 10,000 or more people and has two surface water plants. Therefore, a total of 16 IDSE monitoring sites (8 per plant) are required by the Stage 2 DBPR.

3. Schematic drawing of the distribution system:



4. Summary of typical system operating characteristics:

This section of the report should include a summary of typical system operating characteristics (on a seasonal basis if appropriate) explaining how sources are used to meet system demands, where high water age is expected to occur, and any special aspects of operation that could affect DBP concentrations in the distribution system.

Information about water treatment processes and source water quality data is also part of this section, including a description of water treatment, actual residence times within the water treatment plant and the distribution system, and influent TOC and bromide levels. The average residence time of water in the distribution system is six to eight days.

Available Data:

Report all data that helped in site selection.

Table C.1 Elm City Distribution System - Chlorine Residual (Cl_2) Data

Monitoring Location	Total Chlorine Residual (mg/L)				
	Nov.	Feb.	May	Aug.	Mean
Softwood River Plant or mixed zone representative high HAA5	0.5	0.8	0.9	0.4	0.7
Softwood River Plant representative high HAA5 (IDSE #12)	0.7	0.4	0.8	1.0	0.7
Brown Pike	0.6	0.9	1.1	0.8	0.9
Near Heights	0.6	0.7	0.8	1.2	0.8
Mixed zone representative high TTHM (IDSE #16)	0.6	0.7	0.6	0.6	0.6
Mixed zone representative high TTHM (IDSE #15)	0.2	0.6	0.3	0.2	0.3
Softwood River Plant average residence time (IDSE #11)	0.5	0.3	0.4	0.5	0.6
Softwood River Plant or Mixed zone representative high TTHM	0.8	0.9	1.2	1.1	1.0
Softwood River Plant average residence time (IDSE #10)	0.6	0.6	0.5	0.9	0.7
Softwood River Plant entry point (IDSE #9)	1.4	1.2	0.9	1.7	1.3
Gray Sq	0.3	0.6	0.3	0.2	0.4
Pink Ln	0.2	0.3	0.5	0.3	0.6
Oak Dr	0.8	0.9	0.3	0.8	0.7
Sea Dr	0.2	0.8	0.8	0.5	0.6
River Rd	0.2	1.0	0.7	0.1	0.6
Lake Ave	0.9	0.7	1.0	1.2	1.0
Hardwood Plant representative high TTHM (IDSE #6)	0.9	1.2	1.0	0.8	1.0
Hardwood plant entry point (IDSE #1)	1.6	1.4	1.6	1.5	1.5
Hardwood Plant average residence time (IDSE #2)	0.8	0.6	0.9	0.8	0.8
Hardwood plant representative high HAA5 (IDSE #4)	0.6	0.2	0.5	0.4	0.4
Mixed zone representative high TTHM (IDSE #8)	0.0	0.1	0.1	0.3	0.1
Hardwood Plant or mixed zone representative high TTHM (IDSE	0.2	0.2	0.2	0.5	0.3
Hardwood Plant average residence time (IDSE #3)	0.6	0.4	0.4	0.4	0.5
Hardwood Plant representative high HAA5 (IDSE #5)	0.0	0.2	0.0	0.1	0.1

Table C.2 Elm City Distribution System - Heterotrophic Plate Counts (HPC) Data

Monitoring Location	HPC (#/mL)				
	Nov.	Feb.	May	Aug.	Mean
Softwood River Plant or mixed zone representative high HAA5	50	34	63	113	65
Softwood River Plant representative high HAA5 (IDSE #12)	53	64	123	94	83
Brown Pike	56	42	276	345	180
Near Heights	82	136	246	146	152
Mixed zone representative high TTHM (IDSE #16)	66	53	53	153	81
Mixed zone representative high TTHM (IDSE #15)	70	212	332	356	242
Softwood River Plant average residence time (IDSE #11)	54	65	65	573	189
Softwood River Plant or Mixed zone representative high TTHM	69	43	43	37	48
Softwood River Plant average residence time (IDSE #10)	43	34	224	156	114
Softwood River Plant entry point (IDSE #9)	67	14	42	35	40
Gray Sq	140	215	615	557	382
Pink Ln	280	163	263	446	288
Oak Dr	50	42	522	223	209
Sea Dr	140	66	236	364	201
River Rd	196	45	425	653	330
Lake Ave	53	42	72	84	63
Hardwood Plant representative high TTHM (IDSE #6)	35	43	45	64	47
Hardwood plant entry point (IDSE #1)	12	8	12	34	17
Hardwood Plant average residence time (IDSE #2)	78	86	364	384	228
Hardwood plant representative high HAA5 (IDSE #4)	34	76	89	97	74
Mixed zone representative high TTHM (IDSE #8)	233	214	546	456	362
Hardwood Plant or mixed zone representative high TTHM (IDSE	156	278	359	169	240
Hardwood Plant average residence time (IDSE #3)	35	62	92	147	84
Hardwood Plant representative high HAA5 (IDSE #5)	68	175	375	399	254

5. Summary of the methodology used to select SMP sample sites:

Present the rationale for the selection of the IDSE sampling locations.

IDSE SMP Site Location

Location Criteria	Number of Sample Locations
Entry to the distribution system	2
Average residence time	4
Representative of high TTHM	6
Representative of high HAA5	4

IDSE sampling sites were selected as follows—

As a general rule, the sampling locations were chosen to represent diverse geographical areas of the distribution system. The location of these sites is marked on the map of the distribution system (section 7 of this appendix). Water quality data obtained from residual chlorine (Table C.1), HPC (Table C.2), Stage 1 DBPR (see section 8 of this appendix), monitoring were used to assist in selection of IDSE monitoring sites.

- Two of the IDSE sampling sites were chosen at the distribution system entry points. One for each of the surface water treatment plants feeding the system (sampling locations 1 and 9).

- Four of the IDSE sampling locations were selected to represent the average residence time of water in the distribution system (sampling locations 2, 3, 10 and 11). Two sites were chosen in areas of the distribution system primarily fed with water from the Softwood River plant, and two sites in areas of the distribution system primarily fed with water from the Hardwood River plant. Free chlorine residual data were used to determine the locations approximating the average residence times. For these sites the residual chlorine concentration was between 35 to 50 percent of the plants effluent concentrations.

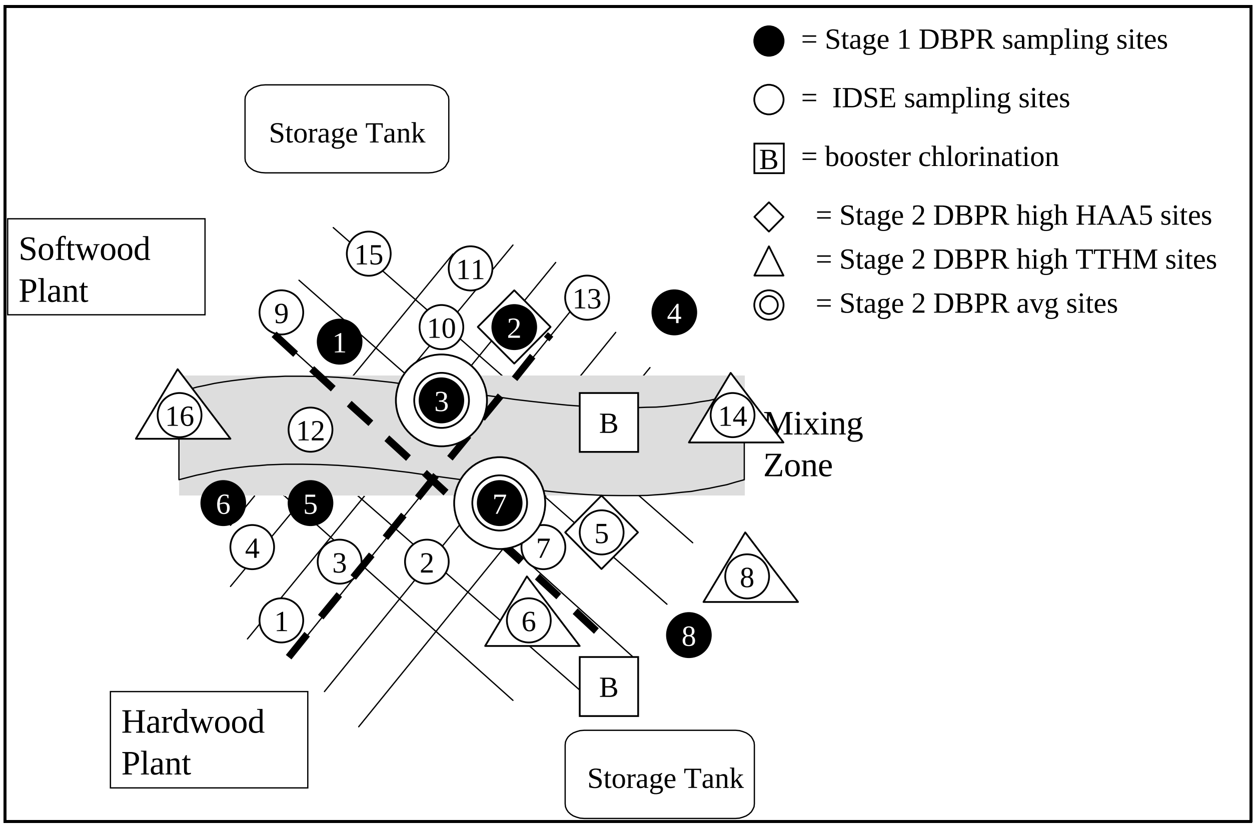
- Six of the IDSE sampling locations were selected to represent the high TTHM concentrations that can develop in the distribution system (sampling locations 6, 7, 8, 14, 15 and 16). In general, these sites were chosen at locations with combinations of long residence time and low chlorine residuals. Sampling locations were not located at the extreme end of the distribution system, but before the last significant group of connections.

- Four of the IDSE sampling locations were selected to represent the high HAA5 concentrations that can be found in the system (sampling locations 4, 5, 12 and 13). Stage 1 DBP data indicate that high HAA5 levels occur primarily during the summer months. In general, these sites were selected at locations with combinations of low chlorine residuals (e.g., 0.2 mg/L) and high heterotrophic plate counts (see Tables C.1 and C.2). Usually, these sites were located at a distance somewhere between locations with average water age and locations selected for high TTHM monitoring.

6. Map of the distribution system showing major transmission mains, numbered Stage 1 DBPR compliance sites, and numbered SMP sample sites:

For the purpose of this example, a schematic representation of the distribution system is shown. However, with the actual IDSE report an authentic map of the distribution system should be provided.

7. Description of SMP sites:



A description of the sixteen IDSE sites proposed for the Elm City distribution system is given here, with a justification for their selection.

IDSE Site #1 - Entry point to the distribution system for Hardwood Water Treatment Plant. This site is located where the first group of customers receive water.

IDSE Site #2 - Represents average residence time of water leaving the Hardwood Plant. We estimated the point where the chlorine decays to about 50 percent of its residual concentration (at the high service pumps). There are no storage facilities between the treatment plant and this location.

<u>IDSE Site #3</u> - Represents average residence time. Water at this location does not go through a storage facility but the chlorine residual is generally 35 to 40 percent of the Hardwood Plant effluent concentration. We attribute this additional loss of chlorine to the fact that the transmission and distribution lines serving this area are older unlined cast iron which have been observed to show significant build-up of corrosion by-products (tubercles). We believe that these corrosion by-products exert a chlorine demand which results in lower chlorine residual at this site although it is probably lower in water age than Site #2.

<u>IDSE Site #4</u> - Represents high HAA5 levels. Sample tap is a hose bib at a building located in a zone of the distribution system with water age greater than average. Water in this area is primarily from the Hardwood Plant. Chlorine residual at this location ranges between 0.2 and 0.6 mg/L, and the heterotrophic plate count is consistently below 100 per mL year round.

<u>IDSE Site #5</u> - Represents high HAA5 levels. This site is a dedicated sampling location used for Total Coliform Rule compliance monitoring. Although chlorine residual levels are often non-detectable at this site, there has never been an occurrence of a heterotrophic plate count greater than 500 per mL or a positive coliform bacteria test.

<u>IDSE Site #6</u> - Represents high TTHM levels. This sampling location is in proximity of the D'Evon Storage Reservoir (a 5.5-MG cylindrical concrete storage facility). The reservoir is located before the mixed zone of the distribution system and is filled with water from the Hardwood plant. A booster chlorination system (which may result in a significant rise in DBP levels) is installed at the outlet of the tank. The sampling location is downstream of the tank after the first group of connections (approximately 0.5 miles) to be representative of water delivered to customers.

<u>IDSE Site #7</u> - Represents high TTHM levels. This site is a dedicated sampling location upstream of the last dedicated sampling location (Site #5) used for Stage 1 DBP monitoring. Both are used for routine Total Coliform Rule and chlorine residual monitoring. We have over 7 years of data from this site. This site is located before the last group of connections near the end of the system, where the water demand tends to be relatively low. Water at this location is generally from the Hardwood Plant, although specific conductivity data show that some mixed zone water can also influence this site.

<u>IDSE Site #8</u> - Represents high TTHM levels. This site is also a routine Total Coliform Rule and chlorine residual sampling location. This site has been problematic in the past for the occurrence of coliform bacteria, non-detectable chlorine residuals, high heterotrophic plate count, and odor complaints. A 4-inch blow-off was installed downstream of this site, but it continues to have poor water quality. Water in this area is from the Hardwood Plant.

<u>IDSE Site #9</u> - Entry point to the distribution system for the Softwood River Water Treatment Plant. This site is located just after the high service pumps at the Water Treatment Plant.

<u>IDSE Site #10</u> - Represents average residence time. The location is used as an alternative site for our coliform and chlorine residual monitoring. (It is within five service connections of a routine coliform location, and used in the event of a positive coliform sample). The routine coliform sampling location is also a Stage 1 DBP Rule location, but the field sampling crews will be able to collect both the coliform samples and the IDSE samples without a major change in the route by using this location.

<u>IDSE Site #11</u> - Represents average residence time. Water does not go through a storage facility but the chlorine residual is generally 35 to 40 percent of the plant effluent concentrations. The transmission and distribution lines serving this area are older unlined cast iron with build-up of corrosion by-products (tubercles) in several areas. We believe these corrosion by-products exert a chlorine demand, lowering chlorine residual while residence time is less than areas with similar chlorine residual concentrations.

<u>IDSE Site #12</u> - Represents high HAA5 levels. The sample tap is a hose bib in a building located in the mixing zone. At this location, the water age is greater than average, the chlorine residual is never below 0.4 mg/L and the heterotrophic count plate is usually low (below 300).

<u>IDSE Site #13</u> - Represents high HAA5 levels. This site is a dedicated sampling location routinely used for Lead and Copper Rule monitoring. Our Stage 1 DBP results indicate the high HAA5 concentrations move around our system depending on the season and production of the Hardwood and Softwood River Plants, especially in the areas served by the Softwood River Plant.

<u>IDSE Site #14</u> - Represents high TTHM levels. This sample site is a faucet at a connection located in a zone of the distribution system that has been recently developed. This connection is located downstream from a chlorine booster station. Chlorine residuals are, normally, in the 0.8 to 1.2 mg/L range. Water in this area is generally a mix of water from the Hardwood and Softwood River Plants.

<u>IDSE Site #15</u> - Represents high TTHM levels. This site is downstream (approximately 12 service connections) from the Jackson Storage Reservoir, a 4 million gallon storage reservoir with an 18-inch common inlet/outlet. The inlet/outlet pipe is an elbow which directs the flow tangentially along the side of the reservoir. There are low chlorine residuals in the service areas fed by this reservoir indicating possible dead zones and poor mixing within the reservoir. Water entering the reservoir is generally a mix of water from the Hardwood and Softwood River Plants.

<u>IDSE Site #16</u> - Represents high TTHM levels. This sampling location is in the mixed zone before the last group of connections near the end of the distribution system. This area sometimes receives water from the Jackson Storage Reservoir or water that bypasses the reservoir. Water from this area can vary greatly in the percentages of Softwood River and Hardwood Plant water.

8. Summary of IDSE SMP data and Stage 1 DBPR compliance data:

IDSE SMP Monitoring Results

IDSE Sample Site	TTHM (ug/L)		HAA5 (ug/L)	
	Data*	Avg	Data*	Avg
#1 - Hardwood Plant entry point	36, 42, 30, 25, 38, 28	33	50, 44, 43, 47, 48, 38	45
#2 - Hardwood Plant average residence time	54, 39, 42, 56, 60, 42	49	22, 29, 36, 40, 41, 30	33
#3 - Hardwood Plant average residence time	47, 40, 52, 43, 51, 41	46	20, 25, 25, 29, 27, 19	24
#4 - Hardwood Plant representative high HAA	33, 29, 41, 42, 44, 22	35	36, 43, 52, 51, 48, 38	45
#5 - Hardwood Plant representative high HAA	35, 40, 41, 37 46, 43	40	60, 59, 64, 55, 66, 54	60
#6 - Hardwood Plant representative high TTHM	62, 71, 82, 75, 81, 65	73	42, 40, 33, 38, 46, 30	38
#7 - Hardwood Plant or mixed zone representative high TTHM	68, 62, 70, 50, 74, 52	63	39, 45, 28, 33, 40, 32	36
#8 - Mixed zone representative high TTHM	65, 61, 73, 71, 72, 64	68	41, 39, 46, 45, 39, 47	43
#9 - Softwood River Plant entry point	40, 42, 49, 38, 38, 46	42	43, 47, 40, 48,	45
#10 - Softwood River Plant average residence time	42, 20, 58, 62, 62, 30	46	23, 56, 40, 52, 40, 28	40
#11 - Softwood River Plant average residence time	47, 50, 41, 54, 48, 40	47	14, 20, 21, 23, 29, 19	21
#12 - Softwood River Plant representative high HAA	35, 29, 47, 37, 47, 27	37	36, 40, 46, 48, 40, 34	41
#13 - Softwood River Plant or mixed zone representative high HAA	52, 35, 46, 42, 50, 38	44	56, 44, 65, 50, 50, 58	54
#14 - Softwood River Plant or mixed zone representative high TTHM	56, 50, 55, 51, 61, 45	53	42, 30, 43, 38, 34, 42	38
#15 - Mixed zone representative high TTHM	48, 56, 70, 52, 65, 49	57	28, 40, 33, 38, 34, 42	35
#16 - Mixed zone representative high TTHM	72, 49, 68, 55, 69, 53	61	20, 21, 38, 28, 19, 35	27

*Data obtained from sampling every 60 days are listed in order for November, January, March, May, August, and November (as required for a surface water supply $10,000).
Note: shaded area identifies sites selected for Stage 2 DBPR monitoring.

Elm City Distribution System - Stage 1 DBP Monitoring Results

Monitoring Location	TTHM (ug/L)		HAA5 (ug/L)	
	Data*	Avg	Data*	Avg
Softwood River Plant average residence time Site Number 1	45, 34, 56, 62	49	24, 32, 43, 45	36
Softwood River Plant average residence time Site Number 2	32, 34, 48, 67	45	42, 47, 55, 56	50
Softwood River Plant average residence time Site Number 3	36, 42, 45, 45	42	50, 62, 67, 68	62
Softwood River Plant maximum residence time Site Number 4	64, 68, 83, 74	72	21, 25, 26, 28	25
Hardwood Plant average residence time Site Number 5	44, 20, 62, 42	42	34, 45, 33, 41	38
Hardwood Plant average residence time Site Number 6	46, 49, 39, 50	46	22, 30, 39, 41	33
Hardwood Plant average residence time Site Number 7	41, 22, 50, 59	43	4, 46, 64, 58	54
Hardwood Plant maximum residence time Site Number 8	73, 50, 67, 58	62	19, 22, 37, 30	27

*Data listed in order for November, February, May, and August quarterly sampling.
Note: shaded area identifies sites selected for Stage 2 DBPR monitoring.

9. Proposed Stage 2 DBPR Sites:

A total of eight (four per plant) Stage 2 DBPR locations were selected from the Stage 1 DBPR and IDSE SMP sites.

Stage 2 Proposed Sample Sites

Sample Site	Site Description
Stage 2 Site No. 1	Stage 1 DBPR average residence time Site Number 3
Stage 2 Site No. 2	IDSE Site #5 - High HAA5
Stage 2 Site No. 3	IDSE Site #6 - High TTHM
Stage 2 Site No. 4	IDSE Site #8 - High TTHM
Stage 2 Site No. 5	Stage 1 DBPR average residence time Site Number 7
Stage 2 Site No. 6	Stage 1 DBPR - High HAA5 Site Number 2
Stage 2 Site No. 7	IDSE Site #14 - High TTHM
Stage 2 Site No. 8	IDSE Site #16 - High TTHM

The criteria for the selection of the eight sampling locations for Stage 2 DBPR monitoring are described here.

- Two of the locations (sites No. 1 and No. 5) are representative of the average residence time of water among Stage 1 locations. Stage 1 Site Number 3 was selected over Site Number 2 because Site Number 2 is being retained as a high HAA5 site.

- Four sites (sites No. 3, No. 4, No. 7, and No. 8) are representative of sites with the highest TTHM identified during the IDSE monitoring.

- Two sites (sites No. 2 and No. 6) are representative of sites with high HAA5 concentrations. One of these two locations (site No. 2) has been selected because it is the IDSE location with the highest HAA5 concentration. The other location (site No. 6) has been selected taking into account results from IDSE and Stage 1 DBPR monitoring. The IDSE location with the second highest HAA5 concentration is site #13. However, comparable levels of HAA5 (within 5 percent) were also detected at the Stage 1 DBPR monitoring location #2, located in proximity (approximately one quarter of a mile) to IDSE Site #13. Based on best professional judgment, this Stage 1 DBPR monitoring location will also be used for Stage 2 DBPR monitoring so that the historical data base available for the Stage 1 DBPR location will be preserved and continued.

Appendix D

IDSE SMP Report for a Ground Water System Serving $ 10,000 People

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Initial Distribution System Evaluation Report for Oak City

PWSID Number: US5555555

Address: 124 Oak Drive
Oak City, US 11111-1234

Contact Person: Mr. Joseph Smith, P.E.

Phone Number: 123-555-1111

Fax Number: 123-555-2222

Email Address: Jsmith@ci.oakcity.us

System Type: Community, ground water

Population Served: 200,000

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This appendix is provided as an example IDSE report for groundwater systems serving 10,000 or more people. The IDSE requirements for these systems are explained in greater detail in Chapter 3 of this manual.

1. System Description:

General system characteristics:

Service area: Oak Springs plus surrounding suburban areas
Production: Annual average daily demand 20 MGD

Source Water Information:

Silver Springs Wellfield (Silver Aquifer)
Blue Springs Wellfield (Blue Aquifer)

Entry points (tied to source(s)) and identification of service area(s) under the influence of each entry point:

Entry points: Silver Plant (Silver Springs Wellfield)
Blue Pumping Station (Blue Springs Wellfield)

The second supply source (Blue Springs Wellfield) is necessary to cope with higher demand during the summer. The two wellfields are located in two different aquifers.

When the Blue Pumping Station is in service, customers located in the Cypressville, Cedarville, Poplarville, and north downtown generally receive water from the Blue Springs Wellfield.

Customers located in the Elmville, Oakville, Pineville, and south downtown generally receive water from the Silver Plant year round.

Customers located in the Weeping Willow Community, Appleville, and central downtown generally receive a mixture of water from both plants when both the Silver Plant and Blue Pumping Station are in service.

Treatment Provided:

Silver Plant: direct filtration, in service 12 months per year
Blue Pumping Station: chlorination, in service three months per year during the summer
Disinfection: Chlorine at both plants

Description of distribution system:

Distribution system (estimated length of lines and range of diameter):
About 600 miles, 4" - 56" (approximately 15 MG carrying capacity)

1 ground tank 4 MG capacity
4 elevated tanks 6 MG capacity

Pump stations:
Station #1 is located at the ground storage tanks. This pump is primarily used during peak demands and low pressure situations. The pump is timed to turn on in the morning and evening during peak demand, and when the pressure drops below 40 psi at a point downstream of the pump station.

Stations #2 and #3. These pumps are used to boost system pressure when the pressure in the areas downstream of these pumps (Oakville and Smallville) drops below 40 psi.

Booster chlorination facilities:
Facility #1 is located on Industrial Park Ave. (downstream from the Courthouse storage tank at pump station #3). This facility is occasionally used during the summer when remote locations downstream of the booster chlorination facility lose residual.

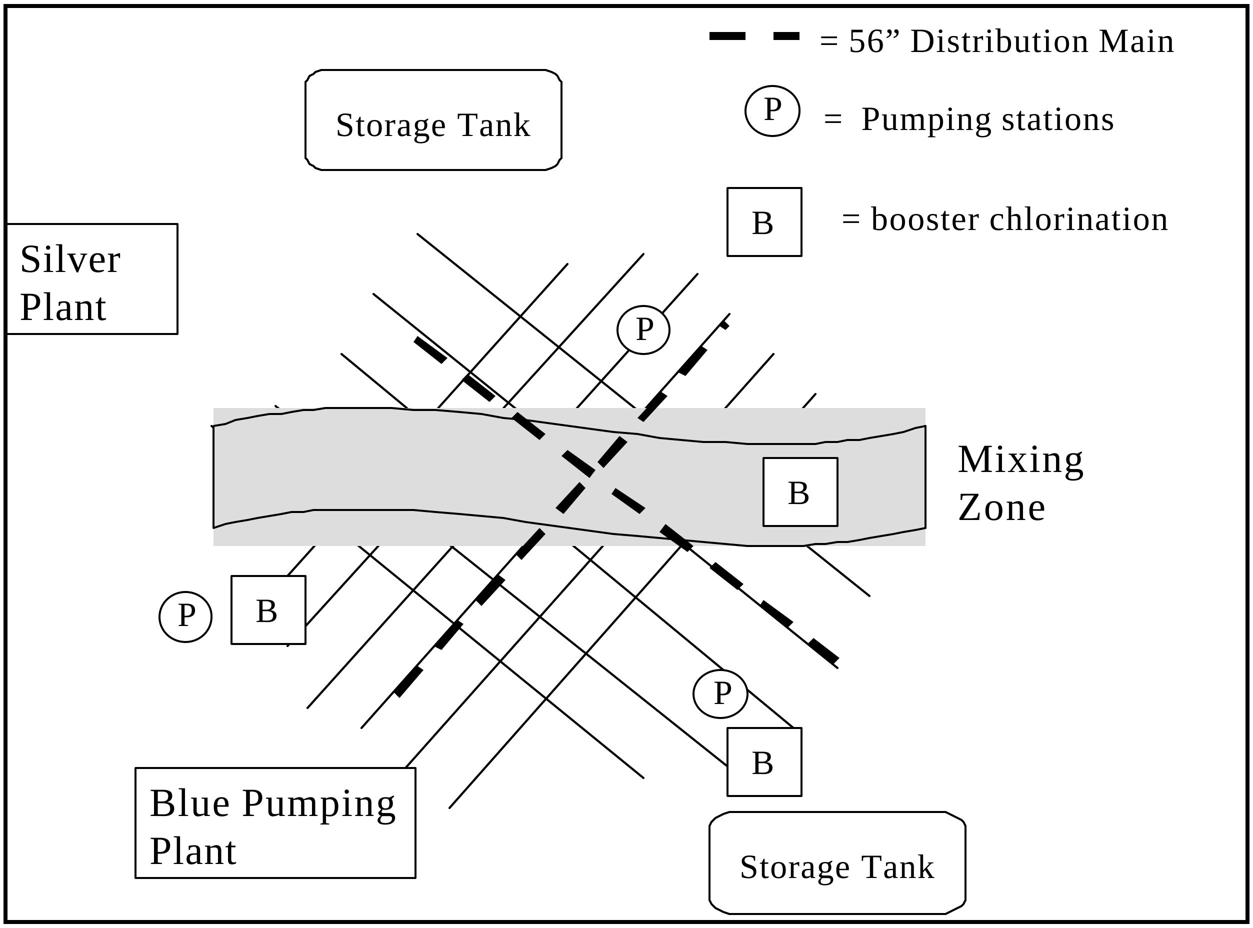
Facility #2 is located at the intersection of First Ave. and 13^{th} St. (in a mixing zone) in an area of the distribution system where chlorine residuals are frequently low.

Facility #3 is located near the Newville Station (downstream of the Station Storage Tank) in an area of the distribution system where chlorine residuals are frequently low.

<u>2. SMP monitoring requirements</u>:

The system serves at least 10,000 and uses two groundwater sources. Therefore, a total of 4 IDSE monitoring sites (2 per plant) are required by the Stage 2 DBPR.

3. Schematic drawing of the distribution system:



4. Summary of typical system operating characteristics:

This section of the report includes a summary of typical system operating characteristics (on a seasonal basis if appropriate) explaining how sources are used to meet system demands, where high water age is expected to occur, and any special aspects of operation that could affect DBP concentrations in the distribution system.

Available Data:

Report all data that helped in site selection.

Table D.1 Oak Springs Distribution System - Chlorine Residual (Cl_2) Data

Monitoring Location	Total Chlorine Residual (mg/L)				
	Nov.	Feb.	May	Aug.	Mean
Brown Pike	0.6	0.9	1.1	0.8	0.9
Near Heights	0.6	0.7	0.8	1.2	0.8
Mixed zone	0.6	0.7	0.6	0.6	0.6
Silver Plant representative high TTHM (IDSE #2)	0.2	0.6	0.3	0.2	0.3
Silver Plant average residence time	0.5	0.3	0.4	0.5	0.6
Silver Plant average residence time	0.6	0.6	0.5	0.9	0.7
Silver Plant entry point	1.4	1.2	0.9	1.7	1.3
Gray Sq	0.3	0.6	0.3	0.2	0.4
Pink Ln	0.2	0.3	0.5	0.3	0.6
Oak Dr	0.8	0.9	0.3	0.8	0.7
Sea Dr	0.2	0.8	0.8	0.5	0.6
River Rd	0.2	1.0	0.7	0.1	0.6
Lake Ave	0.9	0.7	1.0	1.2	1.0
Blue Station entry point	1.6	1.4	1.6	1.5	1.5
Mixed zone representative high HAA5 (IDSE #4)	0.6	0.7	0.5	0.7	0.6
Mixed zone representative high TTHM (IDSE #1)	0.0	0.1	0.1	0.3	0.1
Blue Station representative high HAA5 (IDSE #3)	1.2	0.9	1.1	0.8	1.0

Table D.2 Oak Springs Distribution System - Heterotrophic Plate Counts (HPC) Data (counts/mL)

Monitoring Location	HPC (#/mL)				
	Nov.	Feb.	May	Aug.	Mean
Brown Pike	56	42	276	345	180
Near Heights	82	136	246	146	152
Mixed zone	66	53	53	153	81
Silver Plant representative high TTHM (IDSE #2)	70	212	332	356	242
Silver Plant average residence time	54	65	65	573	189
Silver Plant average residence time	43	34	224	156	114
Silver Plant entry point	67	14	42	35	40
Gray Sq	140	215	615	557	382
Pink Ln	280	163	263	446	288
Oak Dr	50	42	522	223	209
Sea Dr	140	66	236	364	201
River Rd	196	45	425	653	330
Lake Ave	53	42	72	84	63
Blue Station entry point	12	8	12	34	17
Mixed zone representative high HAA5 (IDSE #4)	134	176	189	197	174
Mixed zone representative high TTHM (IDSE #1)	433	214	546	656	462
Blue Station representative high HAA5 (IDSE #3)	35	62	92	80	67

<u>5. Summary of the methodology used to select SMP sample sites</u>:

Present the rationale for the selection of the IDSE sampling locations.

IDSE SMP Site Location

Location Criteria	Number of Sample Locations
Representative of high TTHM	2
Representative of high HAA5	2

IDSE sampling sites were selected as follows—

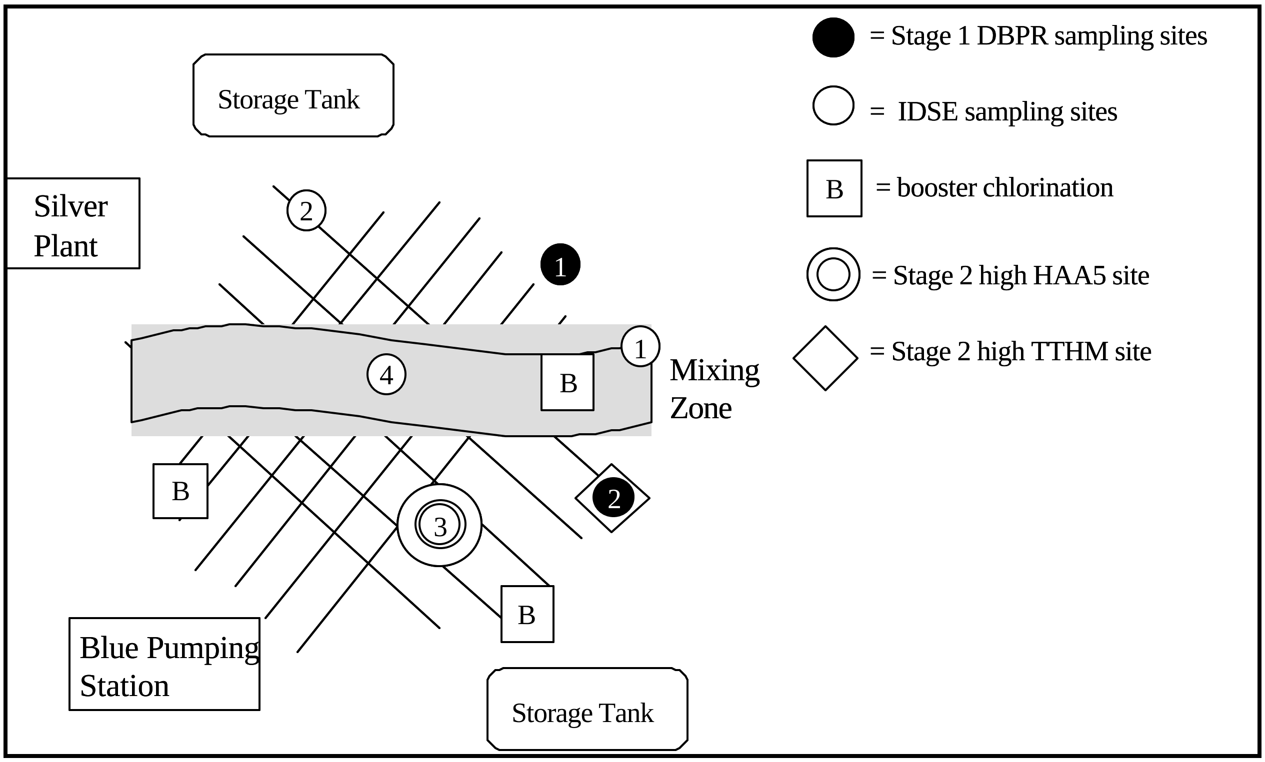
The system has two groundwater water sources. Therefore, a total of four IDSE monitoring sites (two per plant) are required by the Stage 2 DBPR. The location of each monitoring site is marked on the map of the distribution system (see Section 6). Water quality data obtained from residual chlorine, TCR, and Stage 1 DBPR monitoring (see Section 8) were used to assist in selection of IDSE monitoring sites. The utility has a hydraulic model of the city's distribution system. The model provides an estimate of the direction of flow and water age at various locations throughout the system. The city's hydraulic model was used to identify areas with the highest residence times. After overlapping the water age predicted by the hydraulic model and chlorine residual data, about ten separate areas were identified where the potential for TTHM/HAA formation was highest.

- Two of the IDSE sampling sites were selected to represent the high TTHM concentrations that can develop in the distribution system. A review of the water quality data indicates that chlorine residuals were very low (< 0.2 mg/L) at some of the remote areas of the distribution system. The residuals were frequently zero at the ends of the distribution system pipes. The lowest residuals were in areas where there is no commercial activity and the residential population density is low. Among the areas with very low or zero chlorine residuals, some have higher residence times than others (based on hydraulic modeling results. The two proposed IDSE sampling sites were located before the last significant group of connections, rather than at the extreme end of the distribution system,.

- Two of the IDSE sampling sites were selected to represent high HAA5 concentrations. Stage 1 DBP data indicate that high HAA5 levels occur primarily during the summer months. Sites selected were at locations with low chlorine residuals (e.g., 0.2 mg/L) and low (<500 per mL) heterotrophic plate counts. Usually, these monitoring sites were located somewhere between locations with average water age and locations selected for high TTHM monitoring.

6. Map of the distribution system showing major transmission mains, numbered Stage 1 DBPR compliance sites, and numbered SMP sample sites:

For the purpose of this example, a schematic representation of the distribution system is shown. However, with the actual IDSE report an authentic map of the distribution system should be provided.



7. Description of SMP sites:

A description of the four IDSE sites proposed for the Oak Springs metro area distribution system is given below.

IDSE Site #1 - Represents high TTHM levels. This monitoring site is located before the last group of connections in proximity to the end of the distribution system. At this location, water demand tends to be low, chlorine residuals are often undetectable and heterotrophic plate counts are often greater than 500 per mL.

IDSE Site #2 - Represents high TTHM levels. This monitoring site is located after the first group of connections (approximately 0.5 miles) downstream of the Courthouse Reservoir (5 MG elevated storage facility).

IDSE Site #3 - Represents high HAA5 levels. Sample tap is a hose bib at an elementary school located in a zone of the distribution system with water age greater than average. Water in this area is primarily supplied from the Blue Pumping station during the summer months. A booster chlorination station is located at approximately 2 miles upstream of this connection. Chlorine residual at this location ranges between 0.8 and 1.2 mg/L, and the heterotrophic plate count is consistently below 100 per mL all year round.

IDSE Site #4 - Represents high HAA5 levels. This site is a dedicated sampling location routinely used for Lead and Copper Rule monitoring located in downtown Oak City. In this area, the water age is greater than the average, the chlorine residual is never below 0.5 mg/L and the heterotrophic count plate is usually low (below 200 per mL).

8. Summary of IDSE SMP data and Stage 1 DBPR compliance data:

IDSE SMP Monitoring Results

IDSE Sample Site	TTHM (Fg/L)		HAA5 (Fg/L)	
	Monitoring Results*	Avg	Monitoring Results*	Avg
#1 - Representative high TTHM	62, 71, 82, 85	75	21, 25, 26, 28	25
#2 - Representative high TTHM	49, 68, 72, 69	65	20, 21, 38, 28	27
#3 - Representative high HAA	33, 29, 41, 42	36	43, 52, 48, 38	45
#3 - Representative high HAA	35, 29, 37, 47	37	36, 40, 46, 40	41

*Data obtained from sampling every 90 days are listed in order for November, February, May, and August (as required for groundwater supply $10,000).
Note: shaded area identifies sites selected for Stage 2 DBPR monitoring.

Oak City's Distribution System - Stage 1 DBPR monitoring results, TTHM and HAA5 (ug/L)

Monitoring Location	TTHM (ug/L)		HAA5 (ug/L)	
	Monitoring Results*	Avg	Monitoring Results*	Avg
Maximum residence time #1	45, 34, 56, 62	49	24, 32, 43, 45	36
Maximum residence time #2	60, 68, 98, 68	74	42, 33, 38, 30	36

*Data obtained from sampling every 90 days are listed in order for November, February, May, and August (as required for groundwater supply $10,000).
Note: shaded area identifies sites selected for Stage 2 DBPR monitoring.

<u>9. Proposed Stage 2 DBPR Sites</u>:

Two Stage 2 DBPR sampling locations were selected from the Stage 1 DBPR and IDSE sample sites. The high TTHM site selected is one of the Stage 1 DBPR (Stage 1 DBPR site #2) monitoring locations. The average TTHM concentration at this location is 74 Fg/L, which is not significantly lower than the highest average TTHM concentration at the IDSE sample sites (75 Fg/L). However, the average HAA5 concentration at the Stage 1 monitoring location was higher, and this site also had a significantly higher peak TTHM concentration (98 vs. 85 Fg/L). Since the purpose of the Stage 2 DBPR is to identify areas in the distribution with peak DBP levels, this site seemed more appropriate. Maintaining the Stage 1 site will also allow the City to maintain a historical record of TTHM concentrations at this site.

The representative high HAA5 site was the site with the highest concentration among Stage 1 DBPR and IDSE monitoring locations.

Stage 2 Proposed Sample Sites

Sample Site	Site Description
Stage 2 Site #1	Stage 1 DBPR site #2 - Highest TTHMs
Stage 2 Site #3	IDSE site #3 - Highest HAA5

Appendix E

IDSE SMP Report for a
Surface Water System Serving 500 to 9,999 People

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Initial Distribution System Evaluation Report for Lakeside City

PWSID Number: US0000000

Address: P.O. Box 1234
Lakeside City, US 22222-1234

Contact Person: Ms. Mary Smith, P.E.

Phone Number: 123-555-1111

Fax Number: 123-555-2222

Email Address: Msmith@ci.lakeside.us

System Type: Community, surface water

Population Served: 3,000

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This appendix is provided as an example IDSE report for surface water systems serving less than 10,000 persons and opting to complete the Standard Monitoring Program. The IDSE requirements for these systems are presented in greater detail in Chapter 3.

1. System Description:

General System Characteristics:

Service area: Lakeside City - the system serves an area within a three-mile radius
Production: Annual average daily demand 1 MGD

Source Water Information:

Deep Lake
Water quality data:
pH: from 6.8 to 7.9
Alkalinity: from 77 to 94 mg/L as $CaCO_3$
TOC: from 1.6 to 4.4 mg/L as C
Bromide: from 0 (below detection limit) to 0.3 mg/L

Entry points (tied to source(s)) and identification of service area(s) under the influence of each entry point:

Entry points: Deep Lake Plant

Treatment Provided:

Deep Lake Plant: conventional
Disinfection: Chlorine

Description of distribution system:
Distribution system (estimated length of lines and range of diameter):
About 20 miles, 4" - 12" (approximately 1 MG carrying capacity)

2 elevated tanks with total capacity of 0.5 MG

Pump stations:

Station #1 is located near the storage tanks. This pump is primarily used during peak demands and low pressure situations. The pump is timed to turn on in the morning and evening during peak demand, and when the pressure drops below 40 psi at a point downstream of the pump station.

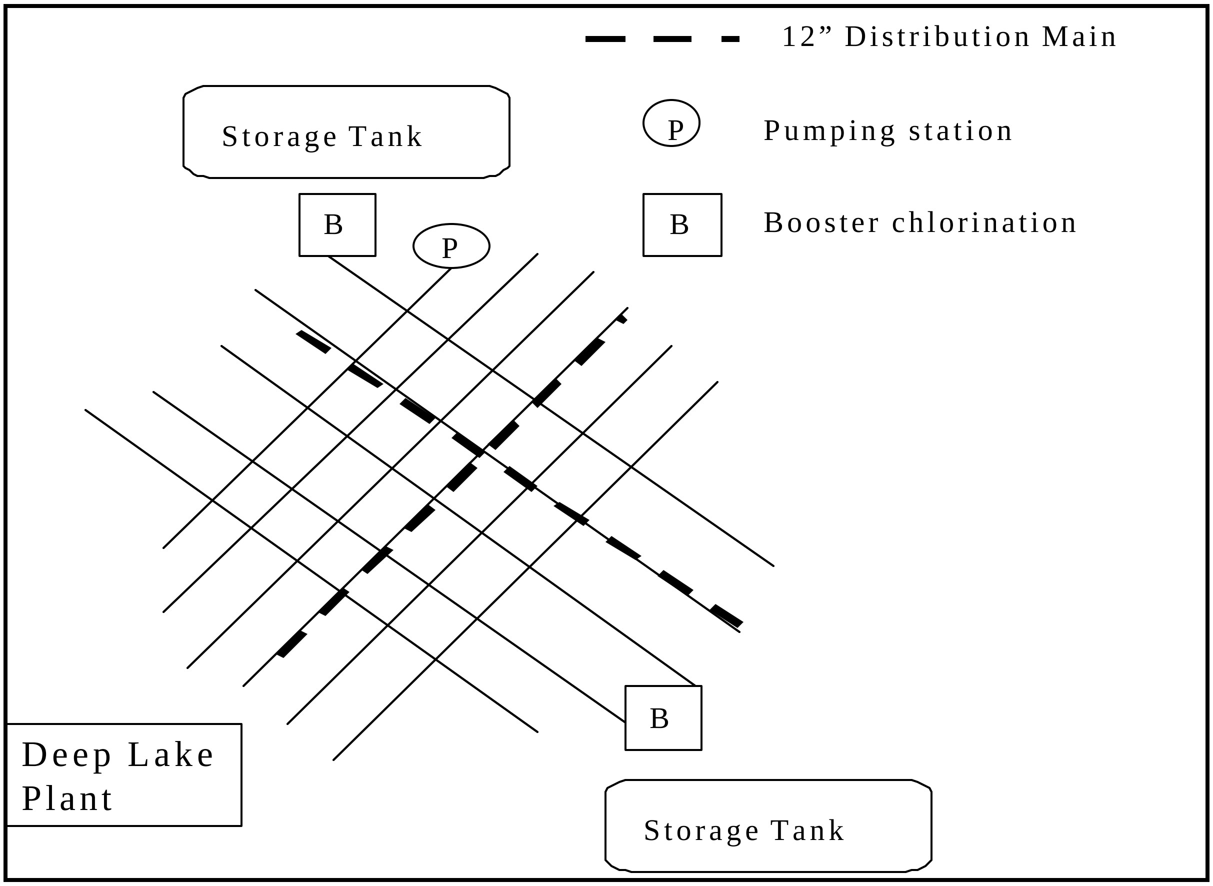
Booster chlorination facilities:

Facility #1 is located on Chestnut Hill Road (downstream from the Chestnut Hill Storage Reservoir) in an area of the distribution system where chlorine residuals are frequently low.

<u>2. SMP monitoring requirements</u>:

Lakeside City is a small system serving <10,000 with one surface water plant. Two IDSE monitoring sites (2 per plant) are required by the Stage 2 DBPR.

<u>3. Schematic drawing of the distribution system</u>:



<u>4. Summary of typical system operating characteristics</u>:

This section of the report includes a summary of typical system operating characteristics (on a seasonal basis if appropriate) explaining how sources are used to meet system demands, where high water age is expected to occur, and any special aspects of operation that could affect DBP concentrations in the distribution system.

<u>Available Data</u>:

Provide tabular summaries of all data used in the selection of your IDSE sampling locations with your IDSE report. Typical data you can include are chlorine residual data, and if available, *HPC data from your TCR monitoring locations. You should also provide a summary of known residence times in this section.*

Residual Chlorine (See Table E.1)
HPC Data (See Table E.2)

The average residence time in the distribution system is approximately 2 days and ranges from less than 1 day to nearly 5 days.

Table E.1 Summary of Chlorine Residual Data at TCR Monitoring Locations

Monitoring Location	Total Chlorine Residual (mg/L)																							
	1/02	2/02	3/02	4/02	5/02	6/02	7/02	8/02	9/02	10/02	11/02	12/02	1/03	2/03	3/03	4/03	5/03	6/03	7/03	8/03	9/03	10/03	11/03	12/03
1. 17 E. Main	0.82	0.70	0.60	0.41	0.35	0.26	0.21	0.16	0.31	0.54	0.75	0.66	0.82	0.70	0.70	0.91	0.55	0.46	0.36	0.28	0.51	0.64	0.75	0.66
2. 45 Maple	0.81	0.75	0.55	0.47	0.42	0.32	0.27	0.22	0.26	0.47	0.68	0.61	0.91	0.75	0.72	0.89	0.54	0.51	0.33	0.31	0.43	0.57	0.69	0.70
2. 33 Mill Street	0.75	0.72	0.75	0.65	0.65	0.60	0.23	0.19	0.15	0.29	0.53	0.51	0.75	0.62	0.75	0.65	0.55	0.40	0.23	0.19	0.25	0.49	0.53	0.51

Table E.2 Summary of HPC Data (if available)

Monitoring Location	Total Plate Count (number/mL)																							
	1/02	2/02	3/02	4/02	5/02	6/02	7/02	8/02	9/02	10/02	11/02	12/02	1/03	2/03	3/03	4/03	5/03	6/03	7/03	8/03	9/03	10/03	11/03	12/03
1. 17 E. Main	7	15	25	17	37	61	75	93	81	47	27	18	7	15	25	17	37	61	75	93	81	47	27	18
2. 45 Maple	8	20	21	30	45	56	33	110	53	57	32	26	5	18	30	23	50	54	90	87	90	51	43	22
2. 33 Mill Street	10	27	14	46	62	73	87	102	93	75	51	30	10	27	14	46	62	73	87	102	93	75	51	30

5. Summary of the methodology used to select SMP sample sites:

IDSE SMP Site Location

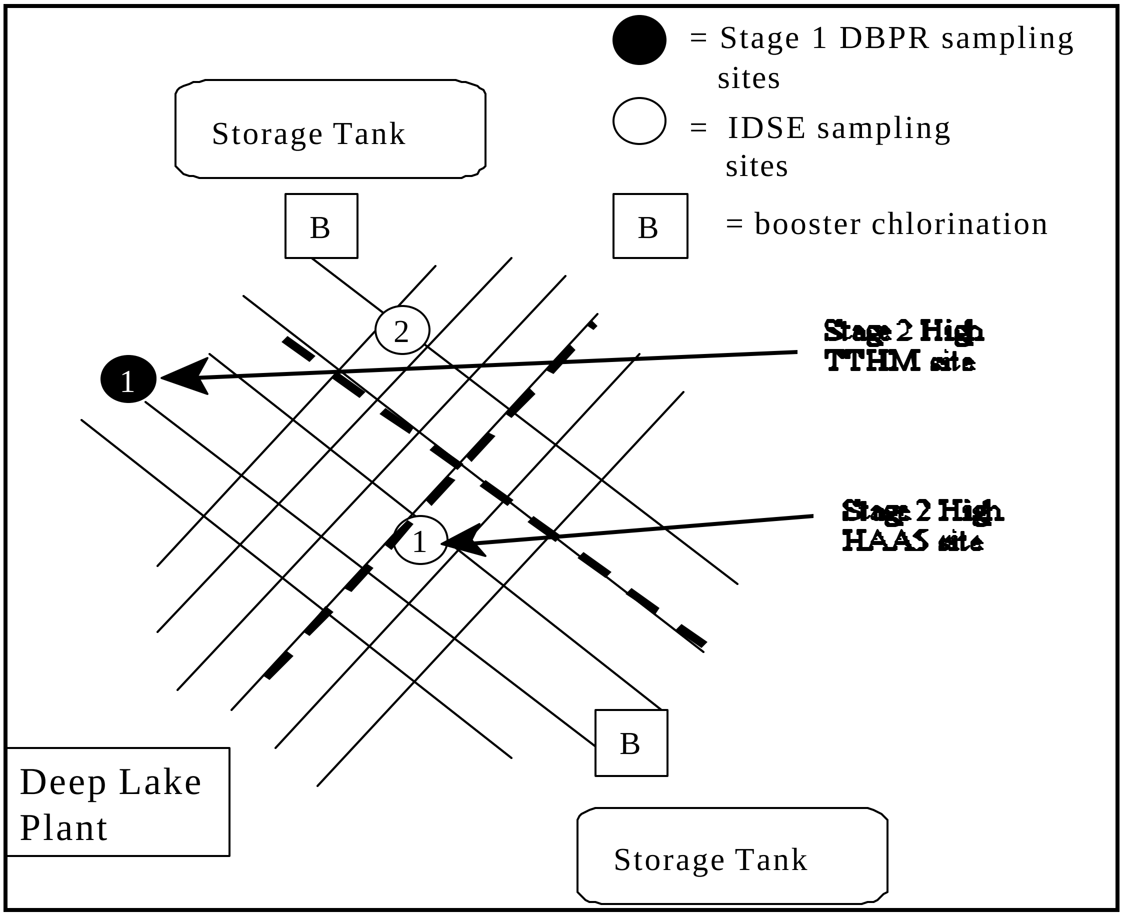
Location Criteria	Number of Sample Locations
Representative of high TTHM and HAA5	2

IDSE sampling sites were selected as follows—

The location of the IDSE sampling sites is marked on the map of the distribution system (see Section 6). Water quality data such as residual chlorine and HPC (obtained from TCR monitoring) as well as Stage 1 DBPR data (see Section 8) were used to assist in selection of IDSE monitoring sites.

6. Map of the distribution system showing major transmission mains, numbered Stage 1 DBPR compliance sites, and numbered SMP sample sites:

For the purpose of this example, a schematic representation of the distribution system is shown. However, with the actual IDSE report an authentic map of the distribution system should be provided. The Stage 1 DBPR sampling plan should also be provided.



7. Description of SMP sites:

The two IDSE sampling sites were selected to represent the high TTHMs and high HAA5 levels that can develop in the distribution system. A description of the two IDSE sites proposed for the Lakeside City distribution system is given here.

<u>IDSE Site #1</u> - Represents high TTHMs and high HAA5 levels. This site is a hose bib in the town library. Water demand is zero at night. It is in the vicinity of the TCR monitoring site located on Maple Street. This site has a low disinfectant residual relative to the system, however, not so low (and HPC data confirms this) that biodegradation of HAA5 is anticipated to be an issue. HPC and disinfectant residual data indicate residence time at this location may be higher than average.

<u>IDSE Site #2</u> - Represents high TTHMs and high HAA5 levels. Water often is stored for long periods in the two elevated tanks at the margin of the city. The site is located in the vicinity of the TCR monitoring location on Mill Street. As with Site #1, this site has a low residual relative to the system, but shows no sign (HPC counts are still low) of the potential for biodegradation of HAAs. When this water is used booster chlorination is required. This practice may result in high DBPs levels. This site is located after the first group of connections downstream of the north elevated storage tank.

<u>8. Summary of IDSE SMP data and Stage 1 DBPR compliance data</u>:

IDSE Monitoring Results

IDSE Sample Site	**TTHM (Fg/L)**		**HAA5 (Fg/L)**	
	Results*	Avg	Results*	Avg
#1 - Representative high TTHMs and high HAA5	60, 72, 84, 72	72	48, 52, 48, 42	48
#2 - Representative high TTHMs and high HAA5	68, 72, 86, 74	75	20, 25, 32, 26	26

*Data listed in order for November, February, May, and August quarterly sampling (as required for surface water supply serving 500 to 9,999).

Lakeside City's Distribution System - Stage 1 DBP Monitoring Results, TTHMs and HAA5 (ug/L)

Monitoring Location	TTHM (ug/L)		HAA5 (ug/L)	
	Results*	Avg	Results*	Avg
Maximum residence time #1	64, 68, 97, 65	74	32, 40, 42, 34	37

*Data listed in order for November, February, May, and August quarterly sampling (as required for systems serving 500 to 9,999).

<u>9. Proposed Stage 2 DBPR Sites</u>:

A total of two Stage 2 DBPR sites were selected from the Stage 1 DBPR and IDSE sites. IDSE Site #1 had the highest average HAA5 concentration and was selected as the high HAA5 site.

The difference in TTHM values between IDSE Site #2 and the Stage 1 site is minimal. However, the Stage 1 location had a considerably higher peak TTHM concentration compared with IDSE Site #2 (97 vs. 86 Fg/L). The Stage 1 site also had a higher average HAA5 concentration. These factors, coupled with the added benefit of maintaining a historical record at the Stage 1 site, led to its selection (rather than IDSE Site #2) as the high TTHM location.

Stage 2 Proposed Sample Sites

Sample Site	Site Description
Stage 2 Site #1 (high TTHM)	Stage 1 DBPR site
Stage 2 Site #2 (high HAA5)	IDSE Site #1

Appendix F

IDSE Report for a Ground Water System Serving < 10,000 People

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Initial Distribution System Evaluation Report for Greenspring City

PWSID Number: US0000000

Address: P.O. Box 1234
Greenspring City, US 11111-1234

Contact Person: Ms. Jennifer Smith, P.E.

Phone Number: 123-555-9876

Fax Number: 123-555-9877

Email Address: Jsmith@ci.greenspring.us

System Type: Community, ground water

Population Served: 1,500

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This appendix is provided as an example IDSE report for ground water systems serving less than 10,000 persons and opting to complete the Standard Monitoring Program. The IDSE requirements for these systems are presented in greater detail in Chapter 3.

1. System Description:

General system characteristics:

Service area: All of Greenspring City—an area of approximately 4 square miles
Production: Annual average daily demand—250,000 gpd

Source water information:

Greenspring Wellfield
Source water quality data:
pH typically ranges from 6.8 - 7.5
Alkalinity ranges from 68 - 310 mg/L as $CaCO_3$
TOC ranges from 0.2 mg/L to 2.1 mg/L
Bromide ranges from 0 (below detection limit) to 0.07 mg/L

Entry points (tied to source and identification of service area under influence of each):

Green Hill Filtration Plant located at Greenspring Wellfield—the only entry point, feeds entire distribution system

Treatment provided:

Green Hill Filtration Plant: direct filtration, in service 12 months per year.
Add chlorine for primary and secondary disinfection
Provide booster disinfection (chlorine) at outlet of the storage reservoir.

Description of distribution system:

Distribution system (estimated length of lines and range of diameter):
About 7 miles, 4" - 12"

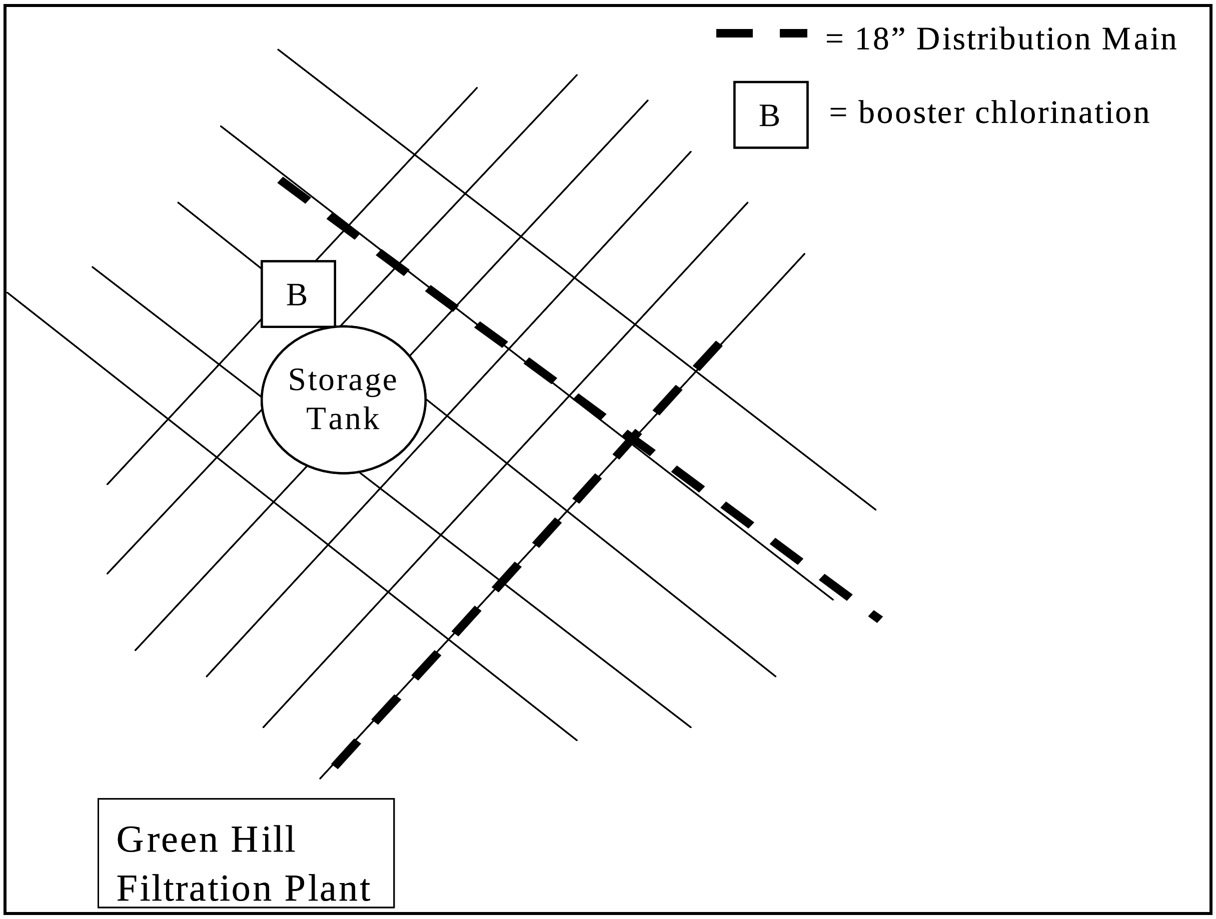
Number of storage tanks and total storage capacity:
1 elevated tank (0.25 MG total)

Booster chlorine facility is located downstream of the storage tank on Route 75. It is used when the chlorine residual leaving the storage tank falls below 0.5 mg/L. Residual is boosted to 1 mg/L.

2. IDSE Standard Monitoring Program Monitoring requirements:

This is a groundwater system, serving fewer than 10,000 people.
System is served by one aquifer. Therefore, for the IDSE, it must sample two locations (one representing high TTHM and one high HAA5) at six month intervals.

<u>3. Schematic of the distribution system</u>:



4. Summary of typical operating characteristics:
This section of the report includes a summary of typical system operating characteristics (on a seasonal basis if appropriate) explaining how sources are used to meet system demands, where high water age is expected to occur, and any special aspects of operation that could affect DBP concentrations in the distribution system. It is not included in this example, but should be a part of your final IDSE report.

<u>Available Data</u>:

Provide tabular summaries of all data used in the selection of your IDSE SMP locations with your IDSE report. This section should also include a range and average residence time for your distribution system.

Residual Chlorine (See Table F.1) and HPC Data (See Table F.2)

Residence time for this system ranges from 0 to 3.5 days, average is approximately 1.5 days.

Table F.1 Summary of Chlorine Residual Data at TCR Monitoring Locations

Monitoring Location	Total Chlorine Residual (mg/L)																							
	1/02	2/02	3/02	4/02	5/02	6/02	7/02	8/02	9/02	10/02	11/02	12/02	1/03	2/03	3/03	4/03	5/03	6/03	7/03	8/03	9/03	10/03	11/03	12/03
1. 567 E. Maple	1.32	1.20	1.20	1.41	1.15	0.96	0.86	0.68	0.81	0.94	1.25	1.16	1.32	1.20	1.20	1.41	1.15	0.96	0.86	0.68	0.81	0.94	1.25	1.16
2. 33 Mill Street	1.25	1.12	1.25	1.15	1.05	0.90	0.73	0.49	0.65	0.79	1.03	1.01	1.25	1.12	1.25	1.15	1.05	0.90	0.73	0.49	0.65	0.79	1.03	1.01

Table F.2 Summary of HPC Data (if available)

Monitoring Location	Total Plate Count (number/mL)																							
	1/02	2/02	3/02	4/02	5/02	6/02	7/02	8/02	9/02	10/02	11/02	12/02	1/03	2/03	3/03	4/03	5/03	6/03	7/03	8/03	9/03	10/03	11/03	12/03
1. 567 E. Maple	7	15	25	17	37	61	75	93	81	47	27	18	7	15	25	17	37	61	75	93	81	47	27	18
2. 33 Mill Street	10	27	14	46	62	73	87	102	93	75	51	30	10	27	14	46	62	73	87	102	93	75	51	30

5. Summary of methodology used to select IDSE SMP sites:

SMP Site Requirements

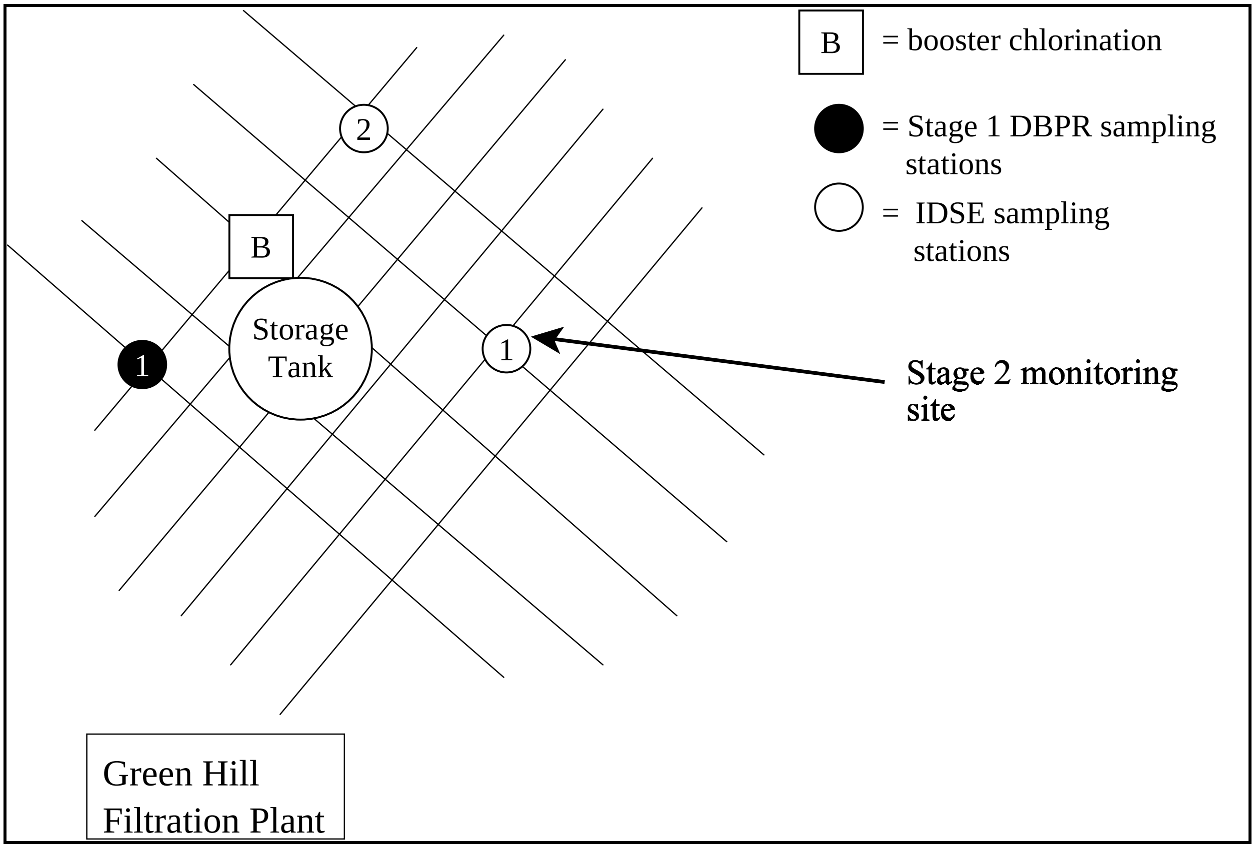
Location Criteria	Number of Sample Locations
Representative high TTHM	1
Representative high HAA5	1

IDSE sampling sites were selected as follows:

SMP monitoring sites were selected to represent the system and identify both high TTHM and HAA5 locations within the distribution system. The location of each site is marked on the schematic below. Water quality data obtained from residual chlorine (Table F.1), HPC (Table F.2), and Stage 1 DBPR (see Section 8 of this report) monitoring were used to assist in selection of IDSE monitoring sites.

6. Map of the distribution system showing numbered Stage 1 DBPR compliance monitoring sites, and numbered IDSE SMP monitoring sites:

For the purpose of this example, a schematic representation of the distribution system is shown. However, with the actual IDSE report a map of the distribution system should be provided. The Stage 1 DBPR sampling plan should also be provided.



7. Description of IDSE sites:

A general description of the two IDSE sites proposed for the Greenspring City distribution system is given here.

<u>IDSE Site #1</u> - Selected because it represents the maximum distribution system residence time (as defined in the guidance manual), and it is anticipated to capture at least the high system TTHMs, if not the high HAA5 levels. This site is a hose bib in the town library (and is located near TCR monitoring location #2 and downstream of the storage tank). Water demand at this location is zero at night. Samples will be collected in the early morning.

<u>IDSE Site #2</u> - Selected because it represents an approximate average system residence time, IDSE site #2 is located at 27 W. First Street. Disinfectant residual monitoring data (Table F.1) show a decline in residual (less than 0.5 mg/L) during August in the vicinity of TCR monitoring location #2 - near IDSE site #1). This location consistently has residuals greater than 0.5 mg/L.

To decrease the potential for biodegradation, IDSE site #2 was chosen in an area expected to consistently have a chlorine residual greater than 0.5 mg/L.

8. Summary of IDSE SMP and Stage 1 DBPR compliance data:

IDSE Monitoring Results

IDSE Sample Site	TTHM (Fg/L)			HAA5 (Fg/L)		
	8/05	2/06	Avg	8/05	2/06	Avg
#1 - Greenspring City Public Library	73	35	54	47	20	34
#2 - 27 W. First Street	45	19	32	40	19	30

Stage 1 DBPR Monitoring Results, TTHMs and HAA5 (Fg/L)

Monitoring Location	TTHM (Fg/L)			HAA5 (Fg/L)		
	8/04	8/05	Avg	8/04	8/05	Avg
1. 321 N. Greenleaf Dr.	57	63	60	47	42	45

*Data from yearly sampling during the month of August.

Proposed Stage 2 DBPR Monitoring Site:

The City of Greenspring is required to select one Stage 2 DBPR monitoring site that represents both the high distribution system TTHM and HAA5 LRAA concentrations. If those do not occur at the same location, then two monitoring locations are required.

Table F.6 lists our proposed Stage 2 DBPR compliance monitoring site.

Stage 2 Proposed Sample Sites

Sample Site	Site Description
Stage 2 Site #1	IDSE Site #1

IDSE site #1 represents both the high distribution system TTHM and HAA5 location. A second IDSE site was monitored (at an approximate average residence time) to see if any biodegradation of HAAs was occurring in the distribution system. The results indicate there is probably not any biodegradation at the public library, as the highest TTHM and HAA5 concentrations were found at that location.

We are abandoning the current Stage 1 monitoring site based upon the results of the IDSE. We considered the value of the historical data, but based on the sampling results during a high temperature month (August) at the Stage 1 site and two IDSE sites, the TTHM concentrations at IDSE site #1 may be 10 to 20 percent (or more) greater than those at the existing Stage 1 location. The sampling results in August also showed that the HAA5 value at the Stage 1 site is not greater than the HAA5 value at IDSE site #1. Therefore, there is no need to retain the Stage 1 site for HAA5 monitoring.

Appendix G

System-Specific Study for a
Surface Water System Serving $ 10,000 People

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Initial Distribution System Evaluation Report for Magnolia City

PWSID Number: US0000000

Address: P.O. Box 1234
Magnolia City, US 11111-1234

Contact Person: Ms. Mary Flower, P.E.

Phone Number: 234-555-1111

Fax Number: 234-555-2222

Email Address: Mflower@ci.magnolia.us

System Type: Community, surface water

Population Served: 360,000

This appendix is provided as an example for systems opting to complete a System-Specific Study using historical DBP data. Chapter 6 presents detailed requirements regarding the use of a SSS for conducting an IDSE.

1. System Description:

General system characteristics:

Service Area: Magnolia plus surrounding suburban areas
Production: Annual average daily demand 35 MGD

Source Water Information:

Grand Falls River
pH: from 6.7 to 7.7
Alkalinity: from 73 to 104 mg/L as $CaCO_3$
TOC: from 1.8 to 5.4 mg/L as C
Bromide: from 0 (below detection limit) to 0.3 mg/L

Entry points (tied to source(s) and identification of service area(s) under the influence of each entry point:

Entry points: River Run Plant

Treatment Provided:

River Run Plant: conventional
Disinfection: Chlorine

Description of distribution system:

Distribution system (estimated length of lines and range of diameter):
About 800 miles, 4" - 56" (approximately 25 MG carrying capacity)

8 elevated tanks (12 MG total)
3 ground level tanks (10 MG total)

Pump stations:
Station #1 is located at the ground level storage tanks. This pump is primarily used during peak demands and low pressure situations. The pump is timed to turn on in the morning and evening during peak demand, and when the pressure drops below 40 psi at a point downstream of the pump station.

Stations #2 and #3. These pumps are used to boost system pressure when the pressure in the areas downstream of these pumps (Flower Village and Friendship Heights) drops below 40 psi.

Booster chlorination facilities:
Facility #1 is located in proximity to Freedom Square (downstream of the Columbus St. storage tank). This facility is occasionally used during the summer when remote locations downstream of the booster chlorination facility lose residual.

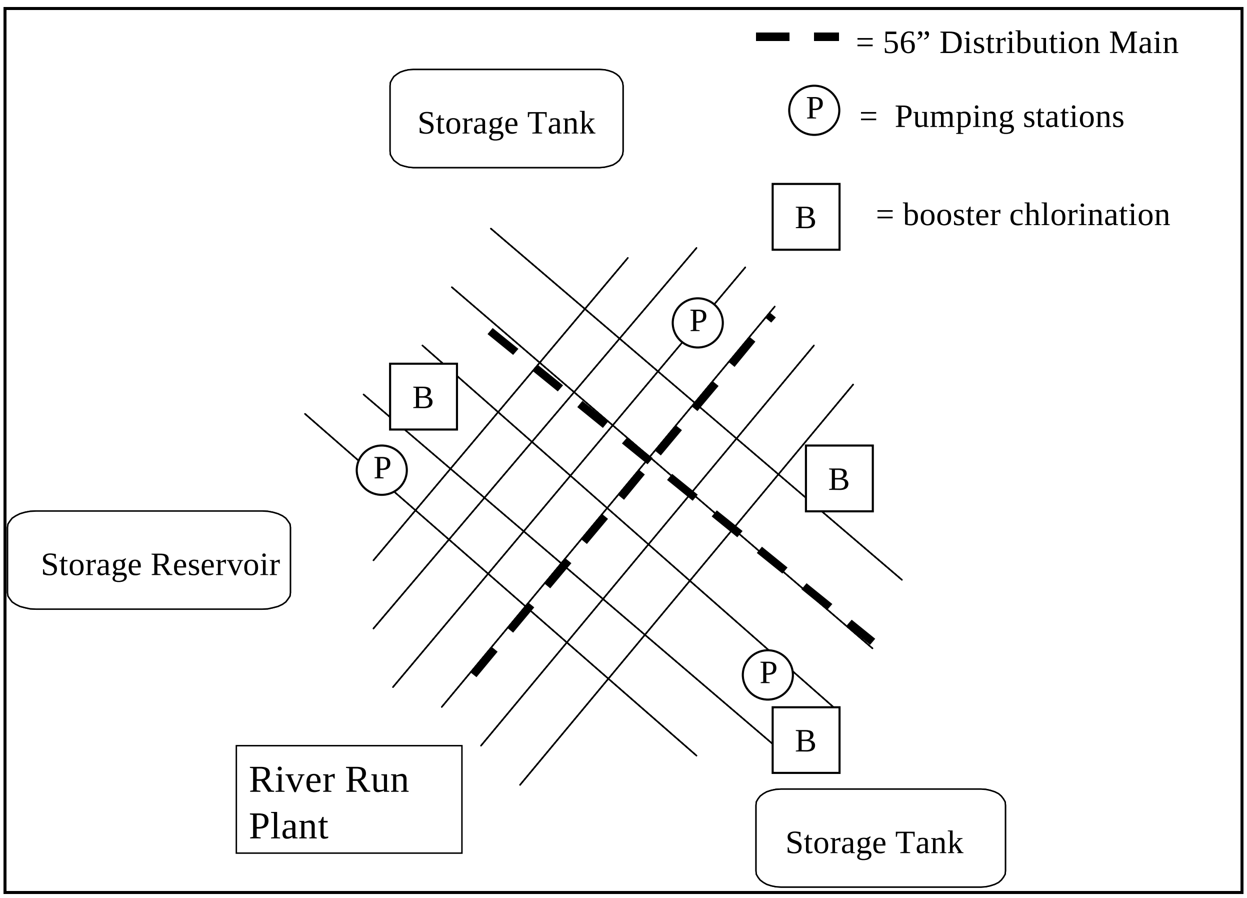
Facility #2 is located at the intersection of Woodstock Ave. and 4th St. in an area of the distribution system where chlorine residuals are frequently low.

Facility #3 is located near the North Village (downstream of the north storage tank) in an area of the distribution system where chlorine residuals are frequently low.

2. SMP monitoring requirements:

Magnolia City is a system serving more than 10,000 that uses one surface water source. Instead of the IDSE SMP, the system has performed an IDSE SSS based on historical system-specific monitoring data that are comparable or superior to data that could be selected at new monitoring sites that represent high DBP levels. Selected sites have been monitored for a period of 5 years (1999-2003).

3. Schematic drawing of the distribution system:



4. Summary of typical system operating characteristics:

This section of the report should include a summary of typical system operating characteristics (on a seasonal basis if appropriate) explaining how sources are used to meet system demands, where high water age is expected to occur, and any special aspects of operation that could affect DBP concentrations in the distribution system.

<u>Available Data</u>:

Chlorine residual data (Table G.1)
HPC data (Table G.2)
Coliform data from TCR (Table G.3)

Table G.1 Magnolia City's Distribution System - Chlorine Residual (Cl_2) Data

Monitoring Location	Nov.	Feb.	May	Aug.	Mean
	Cl_2 (mg/L)	Cl_2 (mg/L)	Cl_2 (mg/L)	Cl_2 (mg/L)	Cl_2 (mg/L)
Lakeshore Dr (historical #7)	0.5	0.8	0.9	0.4	0.7
Dogwood Dr (historical #5)	0.7	0.6	0.8	1.0	0.8
Brown Pike (historical #6)	0.6	0.9	1.1	0.8	0.9
Near Heights (historical #8)	0.7	0.7	0.8	1.2	0.8
Museum Rd (historical #2)	0.6	0.7	0.6	0.8	0.7
Country Club Rd (historical #9)	0.2	0.6	0.3	0.2	0.3
Logan Pl (historical #12)	0.5	0.3	0.2	0.5	0.4
Langley Ave	0.8	0.9	1.2	1.1	1.0
Grant Hill Pl	0.6	0.6	0.5	0.9	0.7
River Run entry point (historical #1)	1.4	1.2	1.3	1.7	1.3
Gray Sq (historical #10)	0.3	0.6	0.1	0.0	0.1
Pink Ln	0.2	0.3	0.5	0.3	0.6
Oak Dr	0.8	0.9	0.3	0.8	0.7
Sea Dr	0.2	0.8	0.8	0.5	0.6
River Rd	0.2	1.0	0.7	0.1	0.6
Lake Ave	0.9	0.7	1.0	1.2	1.0
Hardwood Sq	0.9	1.2	1.0	0.8	1.0
Long Dr	1.6	1.4	1.6	1.5	1.5
Colonial Plaza	0.8	0.6	0.9	0.8	0.8
Butler Pl (historical #4)	0.6	0.2	0.5	0.4	0.4
Sunset Rd (historical #11)	0.0	0.1	0.1	0.3	0.1
Gatewood Ln	0.2	0.2	0.2	0.5	0.3
Morgan Ave (historical #3)	0.6	0.4	0.4	0.6	0.5

Monitoring Location	Nov.	Feb.	May	Aug.	Mean
	Cl_2 (mg/L)	Cl_2 (mg/L)	Cl_2 (mg/L)	Cl_2 (mg/L)	Cl_2 (mg/L)
Central Street	0.0	0.2	0.0	0.1	0.1

Table G.2 Magnolia City's Distribution System - Heterotrophic Plate Counts Data (HPC) (number/mL)

Monitoring Location	Nov.	Feb.	May	Aug.	Mean
	HPC (#/mL)	HPC (#/mL)	HPC (#/mL)	HPC (#/mL)	HPC (#/mL)
Lakeshore Dr (historical #7)	50	34	63	113	65
Dogwood Dr (historical #5)	53	64	123	94	83
Brown Pike (historical #6)	56	42	276	345	180
Near Heights (historical #8)	82	136	246	146	152
Museum Rd (historical #2)	66	53	53	153	81
Country Club Rd (historical #9)	70	212	332	356	242
Logan Pl (historical #12)	54	65	65	93	69
Langley Ave	69	43	43	37	48
Grant Hill Pl	43	34	224	156	114
River Run entry point (historical #1)	67	14	42	35	40
Gray Sq (historical #10)	140	215	615	857	456
Pink Ln	280	163	263	746	363
Oak Dr	50	42	522	223	209
Sea Dr	140	66	236	364	201
River Rd	196	45	425	853	380
Lake Ave	53	42	72	84	63
Hardwood Sq	35	43	45	64	47
Long Dr	12	8	12	34	17
Colonial Plaza	78	86	364	384	228
Butler Pl (historical #4)	34	76	89	97	74
Sunset Rd (historical #11)	233	214	546	656	412
Gatewood Ln	156	278	359	469	315
Morgan Ave (historical #3)	35	62	92	147	84

Monitoring Location	Nov. HPC (#/mL)	Feb. HPC (#/mL)	May HPC (#/mL)	Aug. HPC (#/mL)	Mean HPC (#/mL)
Central Street	68	175	375	399	254

Table G.3 Magnolia City's Distribution System - TCR Data, Total Plate Count (number / mL)

Monitoring Location	Nov.	Feb.	May	Aug.
Lakeshore Dr (historical #7)	36	35	74	95
Dogwood Dr (historical #5)	24	15	45	54
Brown Pike (historical #6)	34	35	36	58
Near Heights (historical #8)	49	54	97	45
Museum Rd (historical #2)	57	35	75	86
Country Club Rd (historical #9)	34	23	66	34
Logan Pl (historical #12)	14	24	64	267
Langley Ave	16	9	23	53
Hardwood Sq	24	15	43	56
Gray Sq (historical #10)	233	257	435	223
Pink Ln	14	23	34	21
Oak Dr	35	26	45	37
Sea Dr	22	20	45	56
River Rd	14	9	35	47
Lake Ave	34	8	25	11
Colonial Plaza	24	12	16	43
River Run entry point (historical #1)	3	7	19	4
Deep Lake Pkwy	25	12	43	56
Easter Ave	4	16	34	22
Western Ave	2	5	11	8
Butler Pl (historical #4)	194	98	286	185
Sunset Rd (historical #11)	24	11	34	24
Gatewood Ln	13	24	43	65
Morgan Ave (historical #3)	23	12	54	134

5. Summary of the methodology used to select historical sample sites:

Historical Sampling Locations

Location Criteria	Number of Sample Locations
Entry to the distribution system	1
Average residence time	4
Representative of high TTHM	5
Representative of high HAA5	2

Historical monitoring sites were selected as follows—

The historical sampling stations were chosen to represent diverse geographical areas of the distribution system, using water quality data obtained from residual chlorine (Table I-1) and TCR data (Table I-3). The extent of this network of 12 monitoring stations is superior to the 8 monitoring stations required by the IDSE SMP for a system under the influence of one surface water source. The sampling sites were distributed as follows—

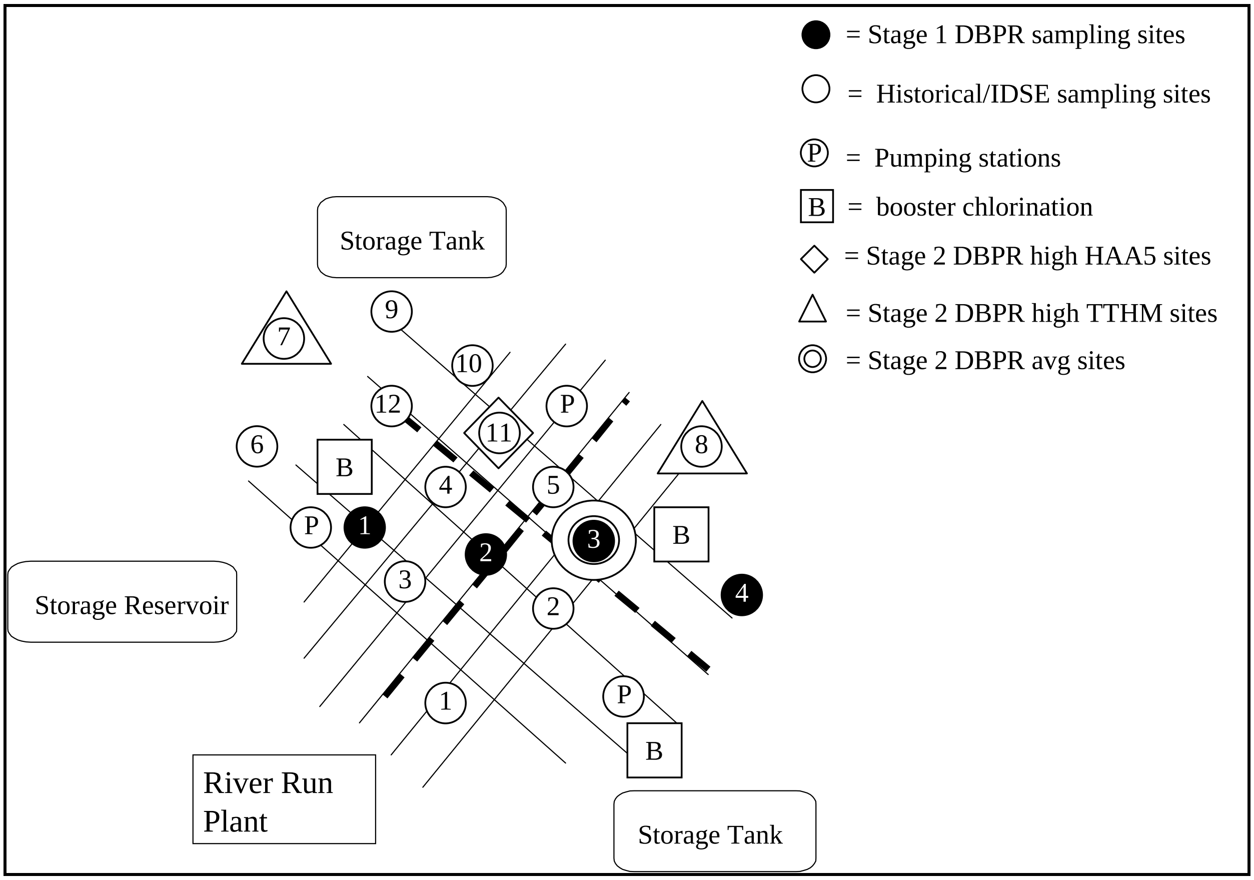
- One of the historical sampling sites was chosen at the distribution system entry point. This matches IDSE requirements.

- Six of the historical sampling locations were selected to represent the average residence time of water in the distribution system. This exceeds the 2 sampling stations required by the IDSE. Free chlorine residuals were used to determine the locations approximating the average residence times. For these sites the residual chlorine concentrations were between 35 to 50 percent of the plant's effluent concentrations.

- Five of the historical sampling stations were selected to represent high TTHMs, and two for monitoring HAA5 concentrations. Only 5 sampling locations for TTHMs and HAA5 combined are required by the IDSE. In general, stations for the monitoring of TTHMs were chosen at locations with combinations of long residence time and low chlorine residuals. Sampling sites were not located at the extreme end of the distribution system, but before the last significant group of connections. Usually, sites for the monitoring of high HAA5 were located somewhere between locations with average water age and locations selected for high TTHM monitoring.

6. Map of the distribution system showing major transmission mains, numbered Stage 1 DBPR compliance sites, and numbered historical sample sites:

For the purpose of this example, a schematic of the distribution system is shown. However, with the actual IDSE report an authentic map of the distribution system should be provided.



7. Description of Historical sites:

A general description of the twelve historical sites used for the monitoring of DBPs in the distribution system is given here.

<u>Historical Site #1</u> - Entry point to the distribution system for River Run Water Treatment Plant. This site is located just after the first significant group of connections downstream of the plant.

<u>Historical Site #2</u> - Represents average residence time of water leaving the plant. We estimated the point where the chlorine decays to about 50 percent of its residual concentration (at the high service pumps). There are no storage facilities between the treatment plant and this location.

<u>Historical Site #3</u> - Represents average residence time. Water at this location does not go through a storage facility, and the chlorine residual is generally 35 to 40 percent of the River Run Plant effluent concentration. We attribute this additional loss of chlorine to the fact that the transmission and distribution lines serving this area are older unlined cast iron which have been observed to have significant build-up of corrosion by-products (tubercles). We believe that these

corrosion by-products exert a chlorine demand which results in lower chlorine residual at this site, although it is probably lower in water age than Site #2.

<u>Historical Site #4</u> - Represents average residence time. The location is used as an alternative site for our coliform and chlorine residual monitoring.

<u>Historical Site #5</u> - Represents average residence time. The chlorine residual at this location is generally 45 to 50 percent of the plant effluent concentration.

<u>Historical Site #6</u> - Represents high TTHM levels. This sampling site is near the Brown Pike storage reservoir (a 5-MG underground storage facility). A booster chlorination system (which may cause a significant rise of DBP levels) is installed at the outlet of the tank. The sampling station is located downstream of the tank after the first group of connections (approximately 0.5 miles) in order to be representative of water delivered to customers.

<u>Historical Site #7</u> - Represents high TTHM levels. This site is a dedicated sampling site upstream of the last dedicated sampling station used for Stage 1 DBP monitoring. Both are used for routine Total Coliform Rule and chlorine residual monitoring. We have over 7 years of data from this site. This site is located before the last group of connections near the end of the system, where the water demand tends to be relatively low.

<u>Historical Site #8</u> - Represents high TTHM levels. This sample site is a faucet at a connection located in a zone of the distribution system that has been recently developed. This connection is located downstream of a chlorine booster station. Chlorine residuals are normally in the 0.7 to 1.2 mg/L range.

<u>Historical Site #9</u> - Represents high TTHM levels. This site is downstream (approximately 12 service connections) from the Colonial Plaza storage tank, a 4 million gallon storage tank with an 18-inch common inlet/outlet. The inlet/outlet pipe is an elbow which directs the flow tangentially along the side of the reservoir. There are low chlorine residuals in the service areas fed by this reservoir, indicating possible dead zones and poor mixing within the reservoir.

<u>Historical Site #10</u> - Represents high TTHM levels. This site has been problematic in the past, with the occurrence of coliform bacteria, non-detectable chlorine residuals, high heterotrophic plate count, and odor complaints. A 4-inch blow-off was installed downstream of this site, but the site continues to have poor water quality.

<u>Historical Site #11</u> - Represents high HAA5 levels. This site is also a routine Total Coliform Rule and chlorine residual sampling location. Although chlorine residual levels are often non-detectable at this site, there has never been an occurrence of a heterotrophic plate count greater than 500 mL or a positive coliform bacteria test.

<u>Historical Site #12</u> - Represents high HAA5 levels. Sample tap is a hose bib at a building located in a zone of the distribution system with water age greater than average. Chlorine residual at this location ranges between 0.2 and 0.6 mg/L, and the heterotrophic plate count is consistently below 100 per mL all year round.

8. Summary of historical data and Stage 1 DBPR compliance data

Historical Monitoring Results (1999-2003)

Historical Sample Site	Year	TTHM (Fg/L)		HAA5 (Fg/L)	
		Monitoring data*	Avg	Monitoring data*	Avg
#1 - Plant entry point	1999	36, 92, 89	72	30, 48, 43	40
	2000	24, 78, 93	65	42, 35, 74	50
	2001	33, 15, 24	24	17, 64, 26	36
	2002	24, 35, 46	35	21, 15, 68	35
	2003	37, 45, 58	47	38, 58, 53	50
#2 - Average residence time	1999	66, 82, 80	76	50, 64, 73	62
	2000	76, 94, 83	84	43, 50, 48	47
	2001	72, 98, 79	83	39, 58, 53	50
	2002	51, 75, 80	69	29, 35, 41	35
	2003	44, 68, 71	61	45, 50, 48	48
#3 - Average residence time	1999	56, 71, 63	63	40, 54, 63	52
	2000	36, 84, 103	74	45, 40, 80	55
	2001	62, 68, 54	61	29, 78, 33	47
	2002	41, 58 , 69	70	24, 23, 74	40
	2003	41, 65, 70	59	47, 63, 59	56
#4 - Average residence time	1999	61, 77, 75	71	35, 49, 58	47
	2000	68, 86, 75	79	47, 42, 67	52
	2001	67, 88, 79	78	23, 58, 43	41
	2002	56, 75, 75	69	34, 33, 54	40
	2003	47, 71, 74	66	43, 68, 63	58
#5 - Average residence time	1999	55, 70, 62	62	41, 55, 64	53
	2000	35, 83, 82	67	44, 39, 79	54
	2001	60, 66, 52	59	27, 58, 32	39
	2002	43, 60 , 71	72	22, 21, 64	37
	2003	39, 63, 69	57	48, 62, 58	56

Historical Sample Site	Year	TTHM (Fg/L)		HAA5 (Fg/L)	
		Monitoring data*	Avg	Monitoring data*	Avg
#6 - High TTHM	1999	85, 71, 93	83	42, 30, 43	38
	2000	82, 92, 102	92	28, 40, 33	34
	2001	70, 72, 95	79	38, 28, 39	35
	2002	61, 81, 85	76	40, 56, 68	55
	2003	68, 76, 80	75	50, 50, 58	53
#7 - High TTHM	1999	82, 69, 83	78	52, 40, 53	48
	2000	92, 102, 112	102	38, 20, 13	24
	2001	90, 92, 105	96	48, 38, 19	35
	2002	71, 91, 95	86	45, 51, 63	53
	2003	88, 96, 100	75	30, 20, 18	23
#8 - High TTHM	1999	75, 80, 82	79	41, 35, 34	43
	2000	65, 103, 112	93	24, 19, 29	24
	2001	60, 106, 152	106	27, 48, 52	42
	2002	53, 80 , 91	75	32, 31, 23	29
	2003	89, 55, 99	81	28, 42, 56	42
#9 - High TTHM	1999	80, 85, 87	84	35, 30, 29	31
	2000	75, 93, 109	92	29, 24, 34	29
	2001	70, 110, 98	93	37, 58, 62	52
	2002	73, 100 , 101	95	35, 36, 28	34
	2003	84, 50, 94	76	31, 39, 59	45

Historical Sample Site	Year	TTHM (Fg/L)		HAA5 (Fg/L)	
		Monitoring data*	Avg	Monitoring data*	Avg
#10 - High TTHM	1999	78, 87, 89	85	39, 34, 33	35
	2000	85, 103, 119	102	27, 25, 35	29
	2001	60, 120, 108	96	36, 57, 61	51
	2002	75, 102 , 103	98	34, 36, 30	33
	2003	54, 70, 114	79	45, 19, 29	31
#11 - High HAA	1999	56, 71, 63	63	51, 65, 64	60
	2000	37, 85, 84	69	49, 59, 79	62
	2001	63, 69, 55	62	27, 68, 72	56
	2002	42, 58 , 69	69	42, 71, 34	49
	2003	41, 65, 71	59	46, 62, 67	58
#12 - High HAA	1999	56, 72, 70	66	45, 59, 68	57
	2000	63, 81, 70	74	57, 52, 77	62
	2001	62, 83, 74	73	33, 68, 53	51
	2002	51, 70, 70	64	44, 43, 64	50
	2003	42, 66, 69	61	53, 68, 83	68

*Data obtained from sampling every 120 days are listed in order for January, May, and September.

The historical monitoring did not include data collected during August—the peak historical month for water temperature and DBPs (based on Stage 1 compliance monitoring provided below). A one time round of additional samples was collected at all historical sites. These data are presented in the following table.

Additional Data Collected at Historical Monitoring Sites During the Peak Month for Water Temperature and DBPs (August 2003)

Historical Sample Site	TTHM (Fg/L)	HAA5 (Fg/L)
	Raw data	Raw data
#1 - Plant entry point	69	46
#2 - Average residence time	78	56
#3 - Average residence time	74	48
#4 - Average residence time	85	59
#5 - Average residence time	92	36
#6 - High TTHM	123	23
#7 - High TTHM	98	53
#8 - High TTHM	152	44
#9 - High TTHM	132	47
#10 - High TTHM	92	26
#11 - High HAA	83	82
#12 - High HAA	90	78

Magnolia City's Distribution System - Stage 1 DBP Monitoring Results for 1999-2003, TTHMs and HAA5 (mg/L)

Monitoring Location	TTHM (mg/L)		HAA5 (mg/L)	
	Raw data*	Avg	Raw data*	Avg
Average residence time #1	45, 34, 51, 67	49	24, 27, 43, 50	36
Average residence time #2	32, 34, 43, 72	45	42, 47, 50, 61	50
Average residence time #3	36, 42, 41, 49	42	50, 62, 62, 73	62
Maximum residence time #4	64, 68, 74, 83	72	21, 25, 26, 28	25

*Data listed in order for November, February, May, and August quarterly sampling.

Stage 2 DBPR Sites Selection:

Stage 2 Proposed Sample Sites

Sample Site	Site Description
Stage 2 Site #1	Stage 1 DBPR average residence time Site #3
Stage 2 Site #2	Historical Site #11 - High HAA5
Stage 2 Site #3	Historical Site #8 - High TTHMs
Stage 2 Site #4	Historical Site #9 - High TTHMs

Four sampling sites were selected from among the Stage 1 DBPR and historical monitoring locations.

- One Stage 2 DBPR monitoring site representative of average residence time must be selected from one of the Stage 1 average residence time locations. Stage 1 monitoring location #3 was retained as the Stage 2 monitoring site representative of average residence time.

- One Stage 2 DBPR monitoring site must be representative of high HAA5 formation. Among all the historical and Stage 1 sites, historical site #12 exhibited the highest average HAA5 value during 1999-2003. However, historical site #11 exhibited the highest HAA5 value during the peak temperature month. Based on our professional judgement, historical site #11 was chosen as the Stage 2 monitoring site representative of high HAA5.

- Two Stage 2 DBPR monitoring sites must be representative of high TTHM formation. Among all the historical and Stage 1 sites, historical sites #7 and #8 exhibited the highest average TTHM values during 1999-2003, as well as highest TTHM values during the peak temperature month. Therefore, we chose historical sites #7 and #8 as the Stage 2 monitoring sites representative of high TTHM.

Appendix H

Example Site Selection Report for IDSE-Exempt Systems

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Stage 2B DBPR Site Selection Report

Date: May 1, 2004

Prepared by: Jane Jones, P.E.

Utility Name: Great Oak Utility District

Utility Contact: Jane Jones, P.E.

Utility Address: 321 Main Street
Great Oak, USA 00000

Phone Number: 123-555-1234
Fax Number: 123-555-4321
E-mail address: JJones@greatoak.ci.us

System Type	Source Water Type	
9 Nontransient noncommunity : Community	9 Ground water : Surface water 9 Both	If you selected "both" - Do you use surface water at least 90 days per year? 9 Yes 9 No

System Size
9 < 500 people
: 500 - 9,999 people
9 $10,000 people

Source Water Descriptions
Blended surface water from Cool Springs and Little River

Number of treatment plants/aquifers: 1 - East WTP

List Stage 2 DBPR Sites

421 Elm Street - high TTHM location (Stage 1 DBPR monitoring site)

567 E. Maple Avenue - high HAA5 location

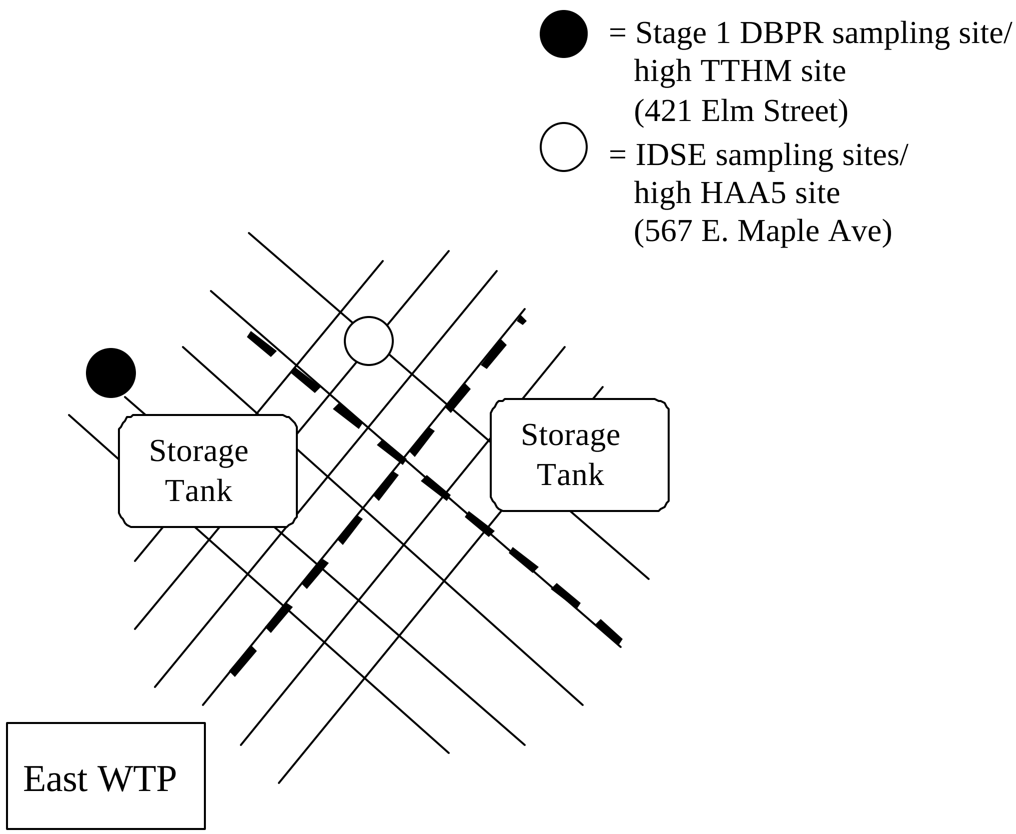
Rationale for Selection (Attach additional sheets as needed)
421 Elm is our Stage 1 monitoring location and will continue to be our high TTHM monitoring location. Our Stage 1 chloramine (total chlorine) residual data showed significant decline in disinfectant residual at this location during warm months (June - September). As a result, we have moved the high HAA5 location to 567 E. Maple. Total chlorine residual at this location was consistently greater than 0.5 mg/L. This also gives us greater geographic coverage of our distribution system. We will monitor both TTHM and HAA5 at each location.

(Include a schematic or map of the distribution system identifying the monitoring sites by number, storage facilities, pump stations, treatment plants, and entry points)

Are any of these also your Stage 1 DBPR Monitoring Sites? : Yes 9 No
(Include a copy of your current Stage 1 DBPR monitoring plan)
If "yes" - please provide a basis for using your Stage 1 DBPR monitoring sites.
421 Elm is our Stage 1 monitoring location and will continue to be our high TTHM monitoring location.

If your system is exempt from the IDSE because your TTHM and HAA5 data are under 40/30 Fg/L, please submit supporting data with this form.

Schematic of Great Oak distribution system.



Summary of Stage 1 Total Chlorine Residual Data for Great Oak

Monitoring Location	Total Chlorine Residual (mg/L)																							
	1/02	2/02	3/02	4/02	5/02	6/02	7/02	8/02	9/02	10/02	11/02	12/02	1/03	2/03	3/03	4/03	5/03	6/03	7/03	8/03	9/03	10/03	11/03	12/03
1. 421 Elm Street	0.95	1.01	0.95	1.21	0.86	0.70	0.45	0.35	0.61	0.82	1.11	1.02	0.95	1.01	0.95	1.21	0.86	0.70	0.45	0.35	0.61	0.82	1.11	1.02
2. 567 E. Maple	1.32	1.20	1.20	1.41	1.15	0.96	0.86	0.68	0.81	0.94	1.25	1.16	1.32	1.20	1.20	1.41	1.15	0.96	0.86	0.68	0.81	0.94	1.25	1.16
3. 1321 Main Street	1.00	1.12	0.97	1.12	0.90	0.75	0.61	0.48	0.64	0.80	1.05	0.97	1.00	1.12	0.97	1.12	0.90	0.75	0.61	0.48	0.64	0.80	1.05	0.97
4. 74 Conover Dr	1.05	0.97	1.12	1.20	0.90	0.79	0.63	0.47	0.70	0.75	0.97	1.02	1.05	0.97	1.12	1.20	0.90	0.79	0.63	0.47	0.70	0.75	0.97	1.02
5. 120 King Ave	1.10	1.00	0.97	1.06	0.82	0.65	0.51	0.39	0.57	0.77	0.94	0.91	1.10	1.00	0.97	1.06	0.82	0.65	0.51	0.39	0.57	0.77	0.94	0.91
6. 33 Mill Street	1.25	1.12	1.25	1.15	1.05	0.90	0.73	0.49	0.65	0.79	1.03	1.01	1.25	1.12	1.25	1.15	1.05	0.90	0.73	0.49	0.65	0.79	1.03	1.01

Summary of Stage 1 DBPR Monitoring Data for Great Oak (421 Elm Street)

Monitoring Location	Feb 2002	May 2002	Aug 2002	Nov 2002	Feb 2003	May 2003	Aug 2003	Nov 2003
TTHM (ug/L)	13	26	31	21	17	25	33	20
HAA5 (ug/L)	9	14	22	17	7	20	25	10